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ABSTRACT

This is a collection of papers presented at an annual conference of the College and University Systems Exchange (CAUSE). Conference activities included a keynote address, general session, and five tracks of presentations: (1) Information Systems Development and Management's Expectations; (2) Information Systems Benefit Analysis; (3) Small College and Information Systems; (4) Vendor Presentations; and (5) Contributed Papers. One paper presented during the general session and 25 papers from the first three tracks of the conference have been reproduced in their entirety for inclusion in this publication. Topics of those papers include: "Information Systems and Institutional Support"; "Integrated Data Base Approach to Student Record Processing"; "Role of an Administrative Data Processing Unit in a Decentralized Planning Process"; "Design and Implementation of an Integrated Financial Control System"; "Computer Indexing and Micrographics: An Integrated Systems Approach"; "Social Cost of Computer Technology"; "An Information System for the Small College"; and "Is a Data Base Management System Feasible for a Small University?" Only the abstracts have been included for the contributed papers and vendor presentations. (JPF)

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Information Systems in Higher Education: Expectations Versus Realities

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Proceedings of the 1977 CAUSE National Conference

December 1977
San Diego, California

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

Edited by
Jan Fretwell
and
Charles R. Thomas

CAUSE

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CAUSE, the Professional Association for Development, Use, and Management of Information Systems in Higher Education, helps member institutions strengthen their management capabilities through improved information systems.

Formerly known as the College and University Systems Exchange, CAUSE first organized as a volunteer association in 1962 and incorporated in 1971 with 25 charter institutions. That same year the CAUSE National Office opened in Boulder, Colorado with a professional staff to serve the membership. Today the organization has grown to 250 member institutions with 900 member representatives and continues to grow at the rate of 10% a year.

CAUSE provides member institutions with many services to increase the effectiveness of their administrative information systems. These services include: the Exchange Library, which is a clearinghouse for non-proprietary information and systems contributed by members; an Information Request Service to locate specific systems or information; consulting services to review ADP organizations and management plans; organizational publications including a bi-monthly professional magazine; and the National Conference.

The CAUSE National Conference provides an excellent forum for the exchange of ideas, systems, and experiences among the many speakers and participants. The proceedings provide a continuing reference to the many activities of the Conference.

David A. Wearley
1977 Conference
Co-chairperson

Janet Fretwell
1977 Conference
Co-chairperson

Charles R. Thomas
Executive Director
CAUSE

INTRODUCTION

In this decade, educational administrators have been faced with limited resources and increased pressures to make informed decisions. They have become increasingly reliant on information systems to satisfy managerial as well as operational needs. An outgrowth of this environment was to view information systems as a panacea -- the ultimate solution to every problem. With this perspective, administrators have frequently found themselves presented with information systems which satisfied basic functions yet did not fulfill their original expectations. The appropriate compromise between expectations and realities is an ever present concern. Thus, the 1977 CAUSE National Conference appropriately focused on "Information Systems In Higher Education: Expectations Versus Realities".

Papers were selected by the Program Committee for presentation at the Conference and inclusion in this publication to emphasize the implications of information systems in higher education, the development of information systems, and the impact of information systems on small colleges and universities.

The contents of this document reflect the Conference activities: the Information Systems Development and Management's Expectations Track; the Information Systems Benefit Analysis Track; the Small College and Information Systems Track; the Vendor Presentations Track; the Contributed Papers Track; the Keynote and General Sessions.

It is hoped that the reader will derive benefit from sharing the experiences of others and therefore become more successful in the development, use, and management of information systems in higher education.

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"AN OVERVIEW OF COLLEGIATE FUND RAISING AND PUBLIC RELATIONS"

Leonard R. Wines
University of Southern California
Los Angeles, California

Inflation continues to soar, and institutional deficits are omnipresent. Thus, fund raising has become even more significant for both state and private colleges and universities. What role can computer services play in fund raising and public relations? Additionally, the presentation will cover special responsibilities of collegiate-based data processing, as well as the joys and blessings of working in higher education.

The primary reason for my being delighted to be here is my belief in the importance of higher education and the work that you and I share together. If by talking about what my colleagues in fund raising and public relations are about, I can help you to enhance your role in your college or university, I will be gratified. I guess this is the right thing to do, if we're doing it together at 8:30 in the morning.

The first thing I am not going to talk about is inflation. I'm taking it for granted that we all have our own example of inflation, both personal and institutional. We're living in an age of pocket calculators and nothing in our pockets to calculate. Incidentally, though, there's a very sure way to slow down inflation. Turn it over to the United States Postal Service.

It goes without saying that inflation continues to soar, and it takes its toll in the form of causing your institution and mine to face the spectre of deficits. If it is a private institution, it's a deficit in the annual operating budget. If it is a public institution it's a deficit as it is manifested in the state legislature and the whole cost of running all institutions in the state. In either event, fund raising has become even more significant for both state and private colleges and universities.

As of last spring 250 colleges had plans to begin capital fund drives of one amount or another. This past September and October there were 71 universities, colleges, and medical centers conducting large scale campaigns. Large scale is defined as a campaign that seeks a minimum of $15 million. Now the aggregate goal of these 71 institutions is $6,292,730,000. Their progress as of two months ago is $4,145,286,000. Twelve of these 71 colleges and universities have goals of more than $100 million each and eight are campaigning at the present time for more than $200 million. My own institution, the University of Southern California, is one of these eight institutions that are seeking sums in excess of $200 million. USC's goal of $265,340,000 is the fourth largest, trailing behind Yale at $370 million; Stanford whose goal was met at $304 million; and Chicago at $280 million.

Now these are figures, and they are probably not definitive figures, for institutions that are engaged in a major capital campaign. This is a special, once in a great while, major fund raising effort and does not account for all the other institutions in the country that are in one form or another continuing to raise important sums of money for themselves on an annual basis. To put all this in a capsule form I would suspect that nearly every institution in the country is looking toward the private sector for the purpose of receiving monies to aid them in their mission and at the very bottom line every institution of higher education in the country has a mechanism to receive dollars should someone contribute any sum to it.

When you look at the entire non profit sector--which includes churches, museums, hospitals, libraries and so on, as well as colleges and universities--you find that these eleemosynary institutions are the recipients of the not inconsiderable sum, if I may be permitted a double negative, of $26 billion per year in the United States. And incidentally, it has been estimated that another $26 billion worth of volunteer services are donated each year to these institutions. So, the money is out there and it is being given.

If yours is one of the very tiniest of institutions that doesn't have someone looking out in one form or another, or one basis or another, for the raising of money then I am certain you have someone who serves in a public information or public relations capacity--someone whose responsibility it is to interpret the institution to the public and to interpret the public to the institution. So my topic is, what role can computer services play in helping institutions to gather understanding and support--what role can computer services play in fund raising and public relations? My answer will be in the form of a description of what development officers, fund raisers, and public relations officers do--what kinds of activities they engage in--and to let you determine what ways computer services can play a role, can augment their activities for the greater good and glory of the institution in question.

I hope you'll forgive me when I tell you that bits and bytes, that hardware and software, that tape drive and disc drive are not part of my daily vocabulary. Hal 9000 scared me a little bit and, if it weren't for C-3PO, I wouldn't understand a thing that R2-D2 was saying. So, what I can do, is to tell you the kinds of things we typically do and need to do and leave it to your judgment and experience on the ways you can help us in our activities.

First of all, I want to share a principle of communication that is germane to everything that takes place in public relations and in fund raising, and the principle is: that communication is best that serves a single target audience. More than any axiom I know, this one works. The more general you make your message the less effective it is. There's an irony here, I think, for people who know how to use computers: on the one hand, a computer is considered by most to be one of the most impersonal devices possible, on the other hand, a computer can enable us to make our messages have a human approach and seem almost intimately personal.

The more specific the message is, directed directly to a defined audience, to try to accomplish certain specified goals, the more effective the message is. Advertising agencies spend most of their time, or at least fully half of their time, in studying the demographics of the media that they will use in their clients' interest. Whether they are looking at print media or broadcast media, they are looking at demographics. In the New Yorker magazine, where advertisers have stood in line over the years, you won't find an ad for Procter and Gamble products. Instead, you will find ads for Tiffany's and Lincoln Continentals. Similarly, in Good Housekeeping magazine Saks Fifth Avenue declines to place their ads.

It goes without saying that the best kind of communication is face to face. A phone call is better than a memo or a letter. Letters targeted to audiences that share certain things in common are better than letters that are addressed "to whom it may concern."

Let me take one kind of collegiate fund raising, the alumni fund, and use it as an example of this communication principle--that that communication is best that serves a single target audience. The alumni are common to all institutions of higher learning and probably the kind of fund raising that is most common to all institutions of higher learning is the annual alumni appeal. One thing that all the members of this target audience have in common is the fact that they have graduated from or attended the same institution and so a letter to this group has this fact as a given. But that ought only to be the start of improving the communication and targeting it to the recipient and probably in this area of fund raising in colleges and universities is where creative data systems can have the largest impact.

Let's ask some questions about this list of alumni. Ought there to be a difference in the communication that we send to the person who graduated in June, 1977, as opposed to the person who graduated in June, 1937? The answer obviously is, yes, there ought to be a difference. The person who got out of school last June may still be looking for a job. He may have borrowed heavily to pay his tuition or his room and board or for his books. The alumnus who is in his 60's, I hope, has made his mark in society. If he is to have accumulated any wealth, he has accumulated it already. The same letter obviously should not go to each alumnus.

More questions. Ought there to be differences in the letters that are mailed to those alumni who have contributed consistently over the years from letters to those alumni who have never contributed at all? Should the person who attended your institution for a full four years receive the same appeal that a person who transferred into your institution in his senior year and graduated after only one year receives? It goes without saying that the kind of fund raising that is most susceptible to being aided by sophisticated information systems are the direct-by-mail campaigns--things like the alumni fund, or the parents campaign. To use the parents as another example: the parent of a student who is on a full scholarship either ought not to get a letter soliciting funds at all, or ought to get, certainly, quite a different appeal from the parent of great wealth and substance.

You have two simultaneous tracks in alumni annual giving. One track is to get a graduate to give for the first time--donor acquisition. The other track is to get a donor who has given before to increase the size of his gift--donor upgrading. It's this donor upgrading that undergirds fund raising at most collegiate institutions.

At the University of Southern California, the staff tries to upgrade a donor until he or she is at or near the $100 level. Then the donor is a candidate for one of the University's 31 support groups, each of whose basic membership dues is $100. The concept of support organizations started at USC 23 years ago with three members in one group for the School of Dentistry. Now 12,715 men and women belong to 31 groups. The largest, Salerni Collegium, for the School of Medicine, has 1,761 members. I happen to be president of the newest support group, and therefore the smallest, with 106 members--the University Staff Club, which is made up principally of staff members of the University.

Within most of the support groups there are gift levels higher than $100. When donors in support groups are at the $500 level, they're then asked to consider membership in the premier support groups: Cardinal & Gold for athletics at $750 and the USC Associates for university-wide academic enrichment at $1000. Corporations and law firms and the like are invited to membership in groups designed for them whose dues start at $2500 per year.

As you would expect, the $1000 a year Associates have $10,000 and $20,000 categories of membership and so on. It's obvious that these members are looked at most closely as prospective donors for large-scale gifts as required by a capital campaign, which I'll outline in a moment.

Throughout all of this, there is a Research and List Department gathering, compiling, and storing information on corporations, foundations, and wealthy individuals. The information is rather detailed--sometimes you feel you're reading an F.B.I. file or something from the inner recesses of the C.I.A. I don't know that you would want to computerize this information, but what you would want in your data banks is the dollar evaluation that has been made on these wealthy individuals. That is, Mr. X is capable of making a gift in excess of $50,000 and Mrs. Y can give $200,000 without feeling any pain.

Research and List information, as well as leads received from advertisements and mailings, are used by the people on staff who are concerned with the category of deferred giving--wills and bequests, charitable remainder trusts, unitrusts, and the like--which we call Donor Financial Planning.

What is the characteristic of a capital campaign? First of all, a relatively large sum of money is being sought. Secondly, it is being sought over a period of time, usually no fewer than three years. The average is five to seven years, sometimes longer. Another characteristic is that there are goals, the attainment of which is being sought. An important characteristic of capital campaigns is that the large gift makes or breaks the campaign. Thus, 90% of your goal comes from 10% of your donors. Perhaps in other campaigns the figures will be 80% of your goal coming from 20% of your donors--but in either ratio one can see that the large gift is crucial.

In our drive at USC for $235,340,000 from private sources, the development officers have determined 56% of that amount will have to come from 26 gifts in the range of $2.5 million to $15 million and over. Another 35% of the $235.3 million will have to come from 275 gifts in the range of $100,000 to $2,499,999. So you can see we are saying that 91% of our goal will come from 301 gifts, the other 9%--or $23,340,000--will take 175,000 gifts.

Now, there's a sequence that, ideally, should be followed in a capital campaign. And the sequence is from the inside out and from the large gift down. What do we mean by the inside out? We mean we start with the people closest to the institution, usually the trustees or regents, who are expected to give dollars themselves to the undertaking in order for them to become successful solicitors of someone else's money. So, usually before a campaign is launched, the regents or the trustees or whatever the governing body is--the body closest to the institution--have solicited themselves and have made significant dollar contributions to the institution. The inside then go outside.

Now, from the big gift down. By the same token, you want to have in hand a certain number of the large gifts and you seek the large gifts before you progressively seek smaller ones. The big gift becomes the bellwether, the criterion by which other gifts are judged, the standard against which other donors are measured. I used the word volunteer a few moments ago and, indeed, capital campaigns are particularly volunteer oriented. That is, the staff, people like me at universities, characteristically do not ask for money. Our job is to do the staff work, to do the research, to put together the proposals, to clear time on the volunteers' calendars. The volunteer is typically the trustee, the person with wealth who will then go after his peer or her peer so as to receive money for the institution. It is a peer group undertaking.

The one program that has less involvement of volunteers typically is the alumni fund. Here the letters are usually prepared by staff, the lists are worked out by staff, the materials are caused to be printed by staff, and the volunteer plays less of a role. But in the large gift fund raising, which make or break a campaign, which make or break an institution, it's the volunteer that counts.

From the alumni fund through the capital campaign, sophisticated information is required on alumni, on friends and potential friends, on donors and potential donors. We need to be able to store and retrieve historical and current information. We need to conduct direct marketing tests, to analyze the importance of the tests and to learn from them. We need fail-safe systems of receiving gifts and accounting for them. We need accurate and timely billing for pledges. Since nothing works better than saying thanks often, information systems must be developed so that gifts can be acknowledged and so that benefactors can be reported to regularly.

Now, let's talk a few minutes about public relations in colleges and universities. As I said at one moment in the beginning, the job of the public relations department is to interpret the institution properly to its various constituencies and, in turn, to act as a channel for the perceptions, needs, and concerns of these publics. The best public relations involves two-way communication and has as its basis good performance, responsible performance.

Now, when interpreting public opinion for an institution, it's important to have accurate gauge of that opinion and here it would seem to me a significant role can be played by information services, by information processing. There is a hierarchy of publics that the college or university has. And the reason I say hierarchy is that I believe that with finite resources, i.e., limited dollars and people, and with the impossibility of reaching all the publics with equal effectiveness, it is important that each institution--or each public relations person in each institution--determine the appropriate rank order or publics for the institution and devote the lion's share of the resources to that public to produce the most efficacious program possible. As I say, the priorities will be different from one institution to another. In a private institution such as my own we place the major part of our effort toward publics that are spelled with a dollar sign. That is, USC concentrates its attention on those constituencies that can most contribute to the financial solvency of the University. So, prospective donors are at the top of our list. And prospective tuition paying students are, also. In another institution, the general public will be the most important one. In still another, legislators will head the list. The publics which colleges and universities have are the same. In no particular order, they are: students; faculty; staff; trustees (or the regents or the governing body); community; parents; alumni, prospective students and their parents; past, present, and prospective donors; opinion leaders; philanthropic foundations; corporations; other educational institutions at secondary and post-secondary levels; the academic community; legislators and governmental officials at city, county, state, and federal levels; and the general public.

An important thing to learn from these publics that one communicates with is how well they're being communicated with. And, so, measurement of the effectiveness of public relations is a crucially important thing; measurement in the form of opinion polls, where they are germane, measurement in the form of readership surveys of individual publications so as to be certain that each publication is doing the job it was intended to do. And of paramount importance, is it meeting the readers' needs? Or, at least, the older, richer readers' needs.

There's no question that information technology can be of significant aid in the conduct of public relations programs. In fact finding, in helping to determine alternative strategies and their cost and time factors, and assisting in evaluation.

Measurement of the efficacy of USC's public relations activities is made on a continuous basis by such means as counting dollars received by the University, utilizing the services of reputable public opinion survey firms, by readership surveys, and by employing clipping services, as well as assessments of general attitudes toward the University.

In closing, I want to point out that those of us in public relations or fund raising in institutions of higher learning, and those of us in information systems in institutions of higher learning, have a special responsibility. And the special responsibility comes from the fact--and I think that this is to our real advantage--that the general public, that people in general, look to us as the standard of excellence. We are the ones that purvey the truth; we're the bastions of unbiased knowledge. And so, in written materials, our verbs must agree with our subjects, our infinitives must not be split. Similarly, our information systems must be equally perfect, from our mailing labels to our gift records. Nothing destroys a single personalized computer letter more thoroughly than receiving its duplicate.

People believe that computers were invented in colleges and universities. While they're willing to accept some error in their Shell card billing or in their statement from Sears (and not much of that), they expect computers based in colleges and universities to be paragons of accuracy and fact. In keeping with the theme of this conference, perfection from collegiate based computer services is an expectation which people have; we have to make certain it is always a reality. Indeed, let it never be said that ours is a house of ill compute.

But if needing to strive for perfection is a disadvantage--and it isn't--of working at an institution of higher learning, it's a relatively minor one. Because together we share something that is probably the biggest fringe benefit of all and that, of course, is working for an institution in society that performs a socially worthwhile purpose. People are better for having gone to college, and people in information systems in particular know this because you work in higher education at a personal financial sacrifice compared to what your salary and perquisites would be in industry.

Our institutions of higher learning, indeed, are the most secure home of hope for the future of society. In them we apply rational thought to the solutions of the great problems, and we search constantly for new truths. In them we seek the cure for the common cold, and for cancer, and the cure for international war. We seek ways of turning urban existence into meaningful civilized living. We strive to learn how to build better bridges, write better laws, practice better medicine.

We store knowledge, and we nurture it.

We discover knowledge, and we share it.

We respect knowledge, and we are its champions.

In short, we are in charge of man's heritage in its passage across the generations. Our goal is to advance this heritage and thus to advance the cause of mankind. This is the most worthy of purposes. And it is particulary appropriate for the membership of CAUSE to advance the cause of man, as it were.

Thank you.

THE INTEGRATED DATA BASE APPROACH TO STUDENT RECORD PROCESSING

Kathryn Molamphy
Systems Analyst

Arlene Slocum
Data Base Technician

University of Kansas
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This paper presents the highlights of the development of the student records information system at the University of Kansas. The student records information system includes subsystems for processing admissions, enrollment, registration, course descriptions, class timetables and permanent records as well as demographic student data. The system incorporates the use of both batch and on-line processing to maintain the integrated data bases in which this information resides.

Our ultimate goal is to provide, in a sophisticated and timely manner, a more accurate and realistic assessment of information on students and courses at the University of Kansas by means of logically related data bases. This paper will outline the analytical design considerations and tradeoffs involved in developing and implementing a system which meets the current demands of the University of Kansas, yet is able to absorb, with minimum impact, procedural changes in information flow.

INTRODUCTION

The University of Kansas is currently in the process of designing and implementing an on-line integrated student records information system (SRIS). This paper discusses the major design advantages associated with implementing this data base system. The approach that was taken in designing this system was to identify all functions which were to be incorporated within the system and concurrently identify all the data elements associated with the system. The integrated data bases were designed after the data elements were identified. The evolution of detailed specifications for each of the major sub-systems followed the data base design phase.

This system is being implemented on an IBM 370/148 operating in an OS/VS1 environment utilizing IMS/DLI and CICS for the on-line support. Attachment A presents a schematic overview of the final data base design along with a brief explanation of the logical relationships of the data base structure.

DESIGN CONSIDERATIONS - The Ability to Absorb Procedural Changes

The overriding goal of SRIS was the design of a system capable of withstanding procedural changes within the Office of Admissions and Records and/or changes dictated by the State Board of Regents. In designing an integrated data base which can withstand major procedural and/or reporting changes, the logical relationships which are an integral part of the data must continue to represent the data relations, otherwise the data base would need to be totally re-designed to allow for those changes, which would require a massive re-programming effort.

User Control Through On-line Entry and Update of Data

One of the easiest ways for the user to make procedural changes is through the sequence by which data is entered and controlled in the system via on-line entry and inquiry. The reporting capabilities are controlled by the user requesting her/his batch reports once the data base reflects the point in time for which the report is to be current. In effect, this gives the user substantial control in determining the sequence of events in a complicated process. However, user control of the sequence of procedures can only be established if the on-line programs have clearly defined functions so these programs can be easily manipulated by the user. Providing the user with more meaningful procedural alternatives increases the user's power to manipulate the system and correspondingly reduces the demands for system or program modification.

Built in Editing Criteria

Another advantage of on-line user interaction in this particular data base environment is in the availability of editing criteria which is automatically built into this structure. For example, if the user attempts to enroll a student in a course which is not being offered for the "specified" year and term, the transaction rejects. This is a further validation than most conventional edits. The term "specified" is an important concept because this is the means by which on-line pre-enrollment can be implemented (i.e. by adding an individual to a course which is being offered for a future year and term).

A second example of internal edit checking is illustrated in the maintenance of the maximum class size field and the number of students currently enrolled field. The system has the capability of only adding a specific number of students to a particular section of a course, since the maximum class size is maintained in the section segment of the data base along with the number of students currently enrolled. The field which contains the number of students currently enrolled is updated whenever a drop or add transaction is applied to the system. Utilizing the logical relationships, as exemplified in the maintaining of an exact correspondence between the number of students enrolled field for a section and the actual number of students enrolled in the section, presents to the user an accurate reflection of the relationships among related data elements in the data base.

Related Student Functions Accomplished Through 'One' On-line Program

On-line entry and inquiry of information by the user is further eased and clarified by the design of 'one' on-line program which is capable of modifying a student's enrollment, dropping or withdrawing a student, and pre-enrolling a student.

Having a single program perform one generalized function has significant consequences. The user benefits from this approach by gaining familiarity with a single set of procedures to perform several tasks, which results in a natural cross-training of office staff and reduces the initial training requirements associated with implementing a new system. The data processing staff benefits by this single program approach through ease of program maintenance, since there is less code to maintain and the code corresponds to the user's view of the function.

Conventional Edit Validations

Of course, the system performs the conventional edit validations against demographical data. This is accomplished in two ways depending upon the volatility of the data. Static data edits, such as the edits performed on a field such as SEX, are hand-coded into the programs. Those fields whose edits vary from term to term (e.g. instructors, current year and term) are validated against a key-sequenced VSAM file (which is called the system control file). The maintenance of the system control file is controlled by the user's office.

It should be noted, however, that even though it is the user's responsibility to maintain the content of the system control file, the data processing staff would need to be utilized in the event of a change in a major coding scheme for any of the information stored on the system control file.

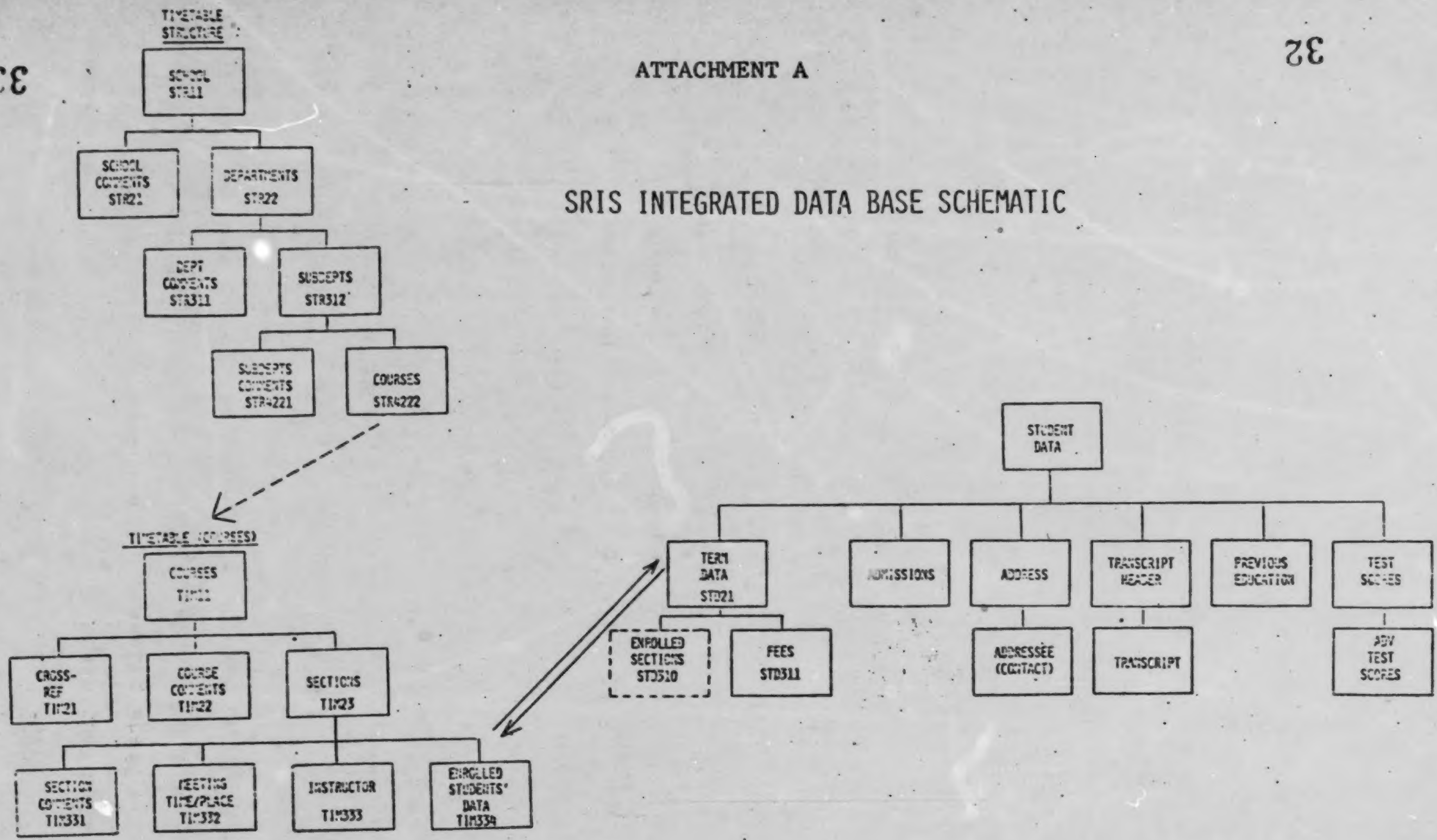
Since all logically related data is subjected to uniform editing criteria as it enters the system, generally no editing is required during the reporting phases of the system. Additionally, logical relationships are created at the time data is entered and stored within the data base, which allows for minimum computer processing in generating batch reports and allows for on-line inquiry to display information in the same sequence as is expected in batch reporting.

Increased Perception and Utilization of Logical Relationships Among The Data Elements

It should be stressed that integrated data bases generally maintain only minimal amounts of redundant data which implies a consistent source of data for reporting and maintenance. This data redundancy reduction is a consequence of integrating the data base. The systems analyst is often able to perceive the relationships between the data fields which have not been recognized previously by the user or conventional data processing methods. Thus, many reports which once required several distinct and unique files can be generated easily and new combinations of data can be grouped together to generate a report.

ATTACHMENT A

SRIS INTEGRATED DATA BASE SCHEMATIC


TIMETABLE STRUCTURE
SCHOOL STR11
SCHOOL CONTENTS STR21
DEPARTMENTS STR22
DEPT CONTENTS STR311
SUBDEPTS STR312
SUBDEPTS CONTENTS STR4221
COURSES STR4222
TIMETABLE (COURSES)
COURSES TIM11
CROSS-REF TIM21
COURSE CONTENTS TIM22
SECTIONS TIM23
SECTION CONTENTS TIM331
MEETING TIME/PLACE TIM332
INSTRUCTOR TIM333
ENROLLED STUDENTS' DATA TIM334
STUDENT DATA
TERM DATA STD21
ADMISSIONS
ADDRESS
TRANSCRIPT HEADER
PREVIOUS EDUCATION
TEST SCORES
ENROLLED SECTIONS STD510
FEES STD311
ADDRESSEE (CONTACT)
TRANSCRIPT
ADV TEST SCORES

EXAMPLES

The following examples demonstrate the utilization of the particular integrated data base design scheme for the Student Records Information System as is implemented at the University of Kansas.

Example I. The Printing of the Timetable

A logical relationship exists between the Timetable Structure data base, which contains the names of all the schools, departments and subdepartments in the University, and the Timetable Course data base, which contains the detailed information for the timetable. The timetable of courses, which contains all sections of all courses, their meeting times, places, and instructors, comments, instructions for enrollment and exam schedules, is printed each semester. The system is designed so that the logical relationship between the Timetable Structure and Timetable Course data bases only exists when the timetable is printed. During all other times these data bases are 'de-linked' and the Structure data base functions as an independent physical data base. The advantage of this feature is that the Timetable Structure and Timetable Course data bases can be updated independently all year. The relationship between a school and all of the courses offered is that school need only be established for the printing of the timetable. Waiting for giant extracts and running of additional computer programs to assure the relationships are eliminated, thereby freeing the user to request the official timetable print whenever he/she feels that she/he has entered into the data base all of the data necessary to print the timetable. In addition, the timetable can be printed for semesters other than the current semester, because each course is identified with the year and term it is offered. Thus, more information is made available to the user without having to develop new procedures or write additional application programs.

Example II. On-line Student Display and Update

The Student data base records can be accessed randomly through two indices; the primary index is the student identification number and the secondary index is the student's social security number. This design provides a cross reference capability on the heart of the system, that is, each individual student. Cross referencing enables the terminal user to search for a student record either through the identification number or the social security number, thus increasing the chances of finding the student in question. The cross referencing also helps to prevent the entering of duplicate records for the same student, since the program will not permit the entering of duplicates on either key. In addition, using the social security number for a secondary index enables applications which identify a student only through the social security number to interface directly with the data base, thereby eliminating the need for maintaining large extract files with redundant information.

DISTRIBUTED DATABASES THE ADAPTABLE APPROACH

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The move toward distributed data bases in state-wide and multi-institutional systems is accelerating. While holding out the promise of making automation available to a wide range of users, distributed data bases will not come into existence by re-applying "traditional" approaches to data processing.

The author argues that current data base software is not well-suited to multi-institutional systems and that the related need to establish standards is grounded in misconceptions.

ACKNOWLEDGEMENT

I wish to express my appreciation to James R. Judy, Vice President for Educational Services for his encouragement and understanding in helping to make this paper possible.

DISTRIBUTED DATABASES THE ADAPTABLE APPROACH

Having databases located at geographically distinct points but operating under the rubric of a single system is generally termed a distributed database or DDB.

Recent advances in the capability and cost of hardware, coupled with the desire to have greater flexibility, control, and security at the various user sites have conspired to make distributing of data attractive.

While local management and control of data can have obvious benefits, there must of necessity exist a centralized control over the data standards to be employed. Almost invariably, the first step toward building a distributed data base is getting agreement on data elements.

In the minds of most systems designers, this means establishing standard field names, standard definitions, field sizes, formats and possibly even field content.

What appears on the surface to be a simple and straightforward (albeit time-consuming) exercise turns out in actual practice to be anything but simple or agreeable.

Building a data dictionary involves at least three necessary constructions:

First, there is the Catalog or Glossary of Definitions. This catalog of definitions is in no way concerned with field lengths, formats, contents or the like. It is concerned only with the properties which a given entity (COURSE CODE for example) must possess in order that it be rendered unique and distinguishable from other entities within the scope of the system (database). This is merely the process of set formation and it should also result in establishing a standard of names.

This is clearly an area where agreement must be achieved and usually can be without too much difficulty. All of the participants in the process have had some prior experience with the entities under consideration and when there is not complete agreement, one can almost invariably develop more basic conceptual entities which can then be re-combined in a variety of ways to meet the needs of the different users of the system.

This exercise is extremely valuable in that it can reveal inconsistencies in existing terminology. A case in point known to this author involved a single institution which had three distinct definitions for the term 'Entering Freshmen'.

1. Less than 12 credits (Billing)
2. Enrolled as freshmen but may have taken summer courses (External agency Definition)
3. Taking first college courses (Student Affairs Office)

An analysis of this term revealed that entering freshmen were not a data element at all and that the various definitions could be constructed out of simpler forms, one of which was #3 (Type 3) above.

1. (Σ (credits) < 12) and (Type 2) or (Type 3)
2. (First college courses in summer) or (First college courses in fall)
3. (First college courses this semester)

In this way a source of confusion was removed.

The second construction involves the establishment of relations and links. COURSE CODE, FINAL GRADE & NUMBER OF CREDITS could reasonably be positied as three naturally related fields with COURSE CODE being a 'keying' or dominating field and FINAL GRADE and NUMBER OF CREDITS being 'carried' or subordinate fields. Links would arise naturally as a result of the consistency in naming conventions. This phase of the data dictionary exercise does lead to some disagreement because it directs itself to the structure of the database to be employed.

There can be significant organizational differences between sister institutions. While a plex or network structure can almost invariably satisfy these conflicting needs, the use of such a configuration raises other issues. There is an increase in complexity which can lead to problems of representing the database to an end-user and limit its overal usefulness. It is felt in many quarters that to represent a database to a user in terms more complex than a hierarchy invites confusion and stifles the development or utility of an end-user facility. While a plex can be transformed into a number of hierarchial views or a single hierarchial view containing dummy connectives, the result is often too large or contrived so that the interests of comprehension are not well served. (Not to mention the problem of redundancy which results.

This area has received considerable attention and solutions to these problems are being found. This is of primary importance and any useable distributed database system must allow for these differences in structure among the various institutions comprising the distributed network.

The third construction and the one which offers the greatest difficulty in achieving initial agreement on data elements is the 'Physical Data Dictionary'. As used here, this means a dictionary which specifies field sizes at the least, and formats, positions and contents in the extreme. Even where there is agreement on the structure of the database, this requirement engenders considerable resistance.

The reasons for this are obvious. The users have already developed their own systems of codification and data representation which are quite diverse and impact the institution at many points. To change over to this new standard will involve real and intangible costs which the institutions are reluctant to bear.

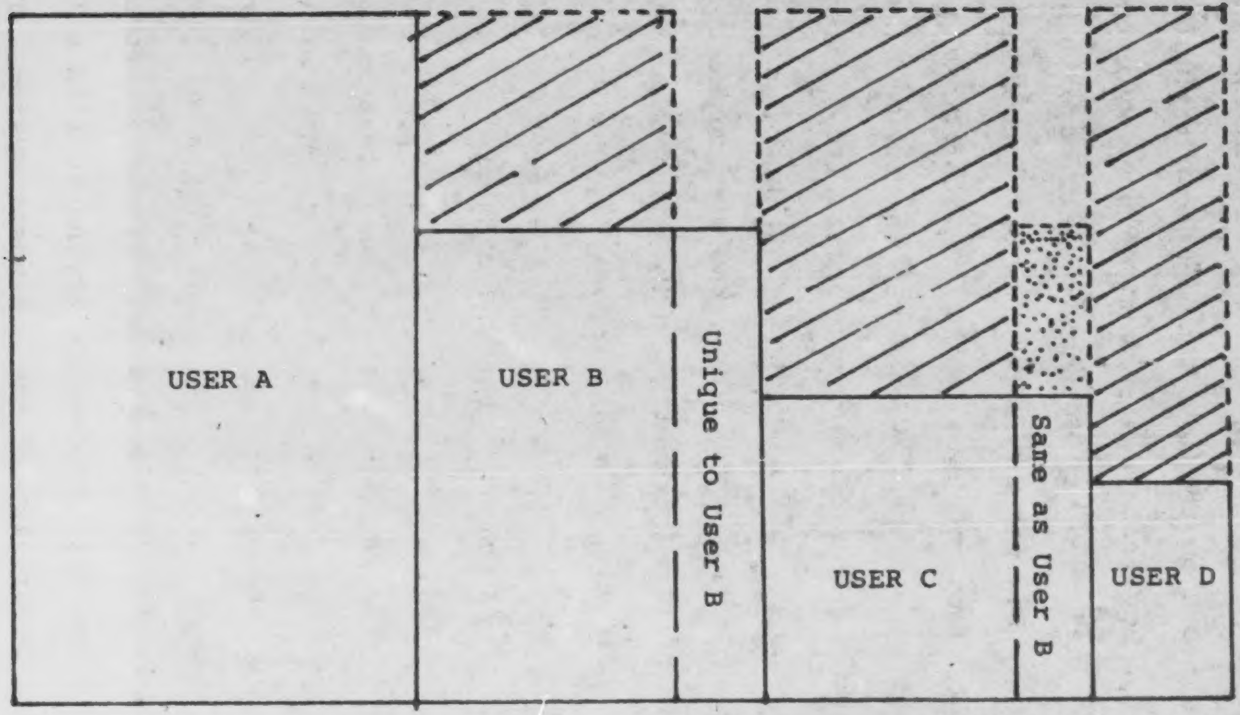
The conventional approach as employed in data processing holds that certain data elements (fields) at least be of a common size. Not only do some DBMS packages require this but there is the apparently convincing argument that this is necessary in order to make software shareable. Consider for the moment the example of a single field 'COURSE CODE'. This field, along with its associated fields, is without doubt the most numerous in a Student Record System. It is also one that shows a great deal of variability between institutions. Not only in size but also in content as well.

Traditionally, the only way to reach agreement on this field is to look at the institution with the largest field size requirement and establish that as the standard size. For argument's sake, let us say that is 20 bytes. Every single institution within the distributed environment would then be required to scale-up its records to this new field size. Figure 1 shows the effect of this, in terms of additional but wasted storage, across the distributed network.

If, in addition to field size, content is also mandated, then the effects on the local, smaller institutions is devastating. For now, catalogs, forms, data entry documents, as well as finely-tuned in-house systems may all have to be redesigned or scrapped. Resistance to this is going to be understandably strong. It is unfortunate that at this stage of the process. one often hears of the 'miscreants' who refuse to conform -- who are anticomputer, fear big-brother, etc., etc.

There can be no denying that a distributed system without standards would be meaningless. While it might qualify as a 'system' in a formal or narrow sense, it would, in reality be an unrelated collection of systems possibly having only a common, shared mainframe. Clearly, an informational and interactional commonality is presumed in the DDB concept.

Unfortunately, in this issue of standards, there appears to be a confusion between data and the representation of it; a lack of appreciation of the reason for such representational diversity; and the absence of software which recognizes the dynamical aspects of data. Along the lines of 'statics' and pre-defined field and record sizes, it was fashionable some years ago to see data processors trying to find a 'correct' fixed length record layout for a student system. This reminded one of the alchemists search for the philosopher's stone and it


USER A
USER B
Unique to User B
USER C
Same as User B
USER D

Single Database with many users distributed spatially

▨ Wasted Storage

produced equally fruitful results.

Consider in the previous scenario what the effect would be if the 'standard' institution found it necessary at some future date to expand its Course Code field size! Which brings us to the added realization that databases can be thought of as distributing over time as well as space. (See Figure 2.) This latter factor has not received the attention it deserves, probably because of the newness of databases themselves. But it promises to become a real issue. As things presently stand, it would be necessary to back out all existing Course Transactions, resize them and then reapply them to the new database. The cost of this to a single institution could be immense and requiring all other units to do the same is out of the question. Not only that, it gives to existing data the status of a potential liability.

The issue of the aggregation of systems should also be considered here. What happens when not just institutions share a database facility, but whole systems of DDB's? No one would seriously propose in such a case that all field sizes be scaled up to meet the needs (read standards) of the new system.

Yet that is exactly what is asked of the institutions comprising the distributed network. What makes the whole issue tragic is that the physical attributes of the data elements have absolutely nothing to do whatsoever with standards.

We almost reflexively think of long neat columns of codes, which are in fact only a short hand 'representation' or handle for an object or conceptual entity.

What we may be losing sight of is that our notions regarding

STORAGE REQUIREMENTS FOR SINGLE USER DATABASE
DISTRIBUTED OVER TIME

(BACKOUT, RESIZE & RETURN)

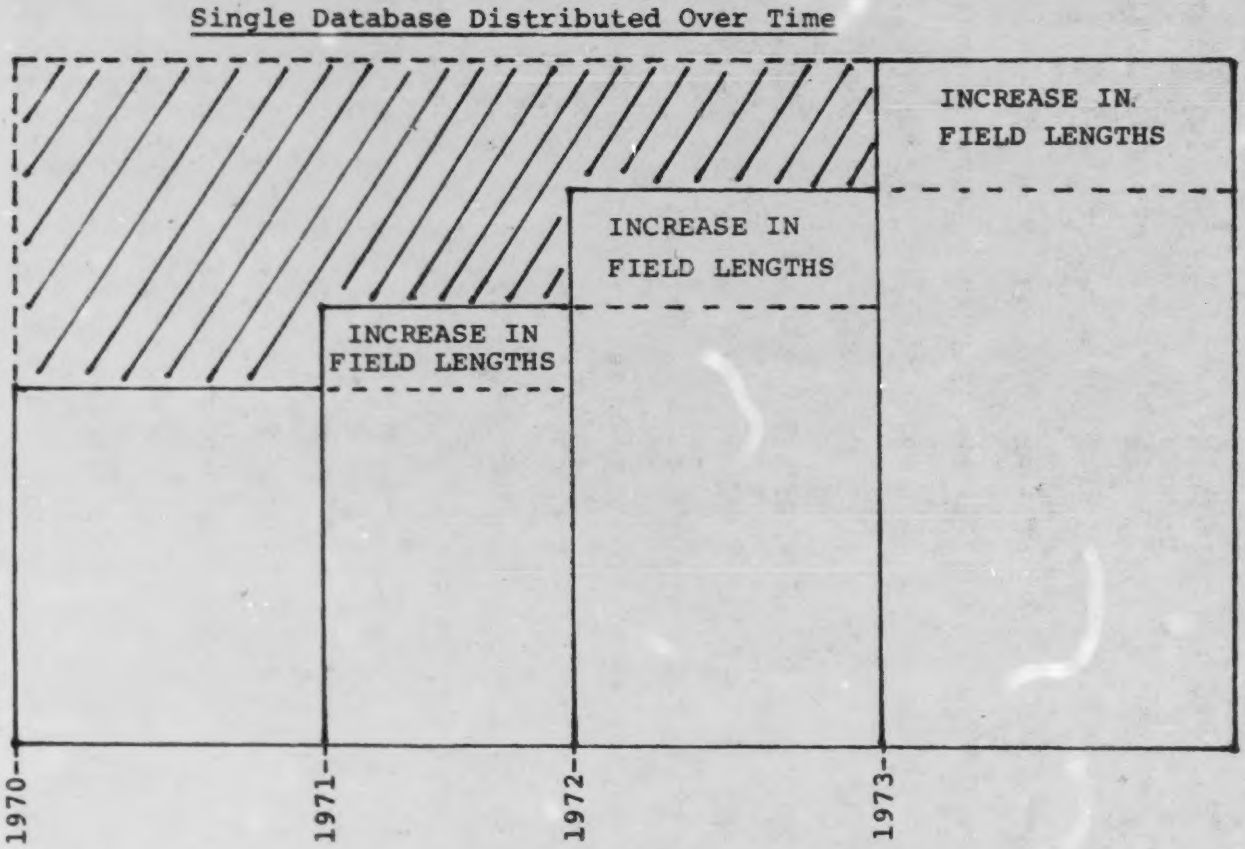


Figure 2

standards have been conditioned by rigid, precomputer machinery and the systems based on it which often required such physical simultaneity in order for them to be useable. Even then it became necessary to introduce various models or sizes of the machinery so that they could better serve the needs of an organization.

Even so, the question remains, can standards be maintained and enforced if we admit of differences in their representation? The answer as we will show is an unqualified 'yes.' One approach which suggests itself, and there may be many, involves establishing a generalized dictionary-driven system which has, in addition to the three constructs previously discussed, a structure table, a table of Equivalents of Useage, and both Global and Local Data Dictionaries. (See Figure 3.)

Under this scheme, the Local Dictionaries, which are embedded in the Database, supply the physical parameters necessary for the particular definition of that institution's data. Only fields mapped to an entry in the Global Dictionary would be recognized and the same would obtain as regards its content except the mapping is now to the Equivalent of Useage table. It is this mapping, and not the physical or contextual identity which brings the standards into existence and gives them substance.

This would allow the institutions considerable latitude with the physical characteristics as well as content of their data without diminishing the integrity of the system's standards. It envisages a state of continuous interplay between the central

LOGICAL ATTRIBUTES		STRUCTURAL CHARACTERISTICS	PHYSICAL ATTRIBUTE	VALUE CONDITIONS	VERSION CODE
Entity	User Name	Structure	Physical Length	Data Type	
Course Code	GLOBAL		20	All	
	A. CRSECD	F-	6	C	2
	B. CODE	H-	5	N	1
	C. COURSE	D-	19	C	1
	.	.	.	.	
	.	.	.	.	
	.	.	.	.	
	J. PEDAG	H-2	7	C	1
Curriculum Code	GLOBAL		10	All	
	A. CURRCD	F	4	N	
	B. CURR	F	2	N	
	C. CURRCL	H	5	C	
	.	.	.	.	
	.	.	.	.	
	.	.	.	.	
	J. MAJR	H	10	C	2

F = Fixed File w/self-definers
H = Hierarchial
D = Direct

Local to Global Physical Data Element Characteristic Map

Figure 3

EQUIVALENT OF USEAGE TABLE

GLOBAL DICTIONARY ENTRIES	LOCAL DICTIONARY ENTRIES			
	USER A	USER B	...	USER J
01.00000000.01	ART001	AR030		01.003.62
01.00000000.02	--	AR002		--
01.00000000.03	ART100	--		--
.	.			
.	.			
.	.			
07.06213577.01	--	GE670		--
.				
.				
.				
99.00000000.01	Z00362	--		90.002.70
99.00000000.02	Z00150	ZL001		--

Local to global data element value map for course code

Figure 3a

facility and the local user. Here control is achieved via understanding and accommodating the user's new and particular needs without disruption to any other members of the system. The fact that the participating units are feeding new definitions and requirements promises to make the system far richer and useful than would otherwise be possible. It goes without saying that such a software capability would allow new users to effectively 'plug-in' to the distributed environment with no impact to the existing users.

If we accept this for the moment, then a different approach to the problem emerges, indeed a different flavor to data processing. This view, which may be termed the 'soft' or adaptable approach, rejects outright the need and the notion that physical standards, valid field values, and record layouts should be imposed from the top but rather, that the system adjust itself to the requirements of its users. In this way the Database Administrator or Data Administrator would function as a coordinator ensuring that new entities were defined in the Glossary of Definitions, that existing ones were correctly mapped and/or had not decayed into disuse.

The history of data processing is replete with such issues and their solution has generally been found in software which is adaptable to more flexible and complex forms. Fixed length records have given way to variable length records which in turn have given way to generalized files and spanned records. In this process, flexibility has generally been achieved by folding more and more self-definition into the records and files and less and less into the application software itself. The question of software shareability in such an environment now assumes major proportions. It might appear that, with so much variability and accommodation, there would have to exist as many versions of a program as there were users and that we are merely achieving data independence at the expense of software and programing.

This does not seem to be true, however. It appears that this problem can best be attacked at a different level. Up to now we have addressed data independence and representational flexibility. What is called for now is software independence.

Generally speaking, however, this independence must be achieved at the operand and length code level of an instruction. Just as data has become freed of the application program, so must software become freed of the restrictions imposed by its basic instruction set. One way that suggests itself is to design a 'high-level', perhaps machine-independent, assembler wherein the operands of the instructions are designed for much more general and conditional addressing that is presently possible.

A typical instruction in such an environment might look like this:

USER VIEW PRINT ADVISOR

ASSEMBLED VIEW (Prior to DD Pass)

Move & Print	Length	ADVISOR	SYS PRNT + 20

Prior to running the program, the Local Data Dictionary is consulted and the operand terms are now replaced with the particular parameters of that field.

ASSEMBLED VIEW
(After DD Pass)

Move	Actual Length	Conditional Flags	Actual Addressing Parameters			Device	Class	Position etc.
			Device	File Class	Position, etc.			

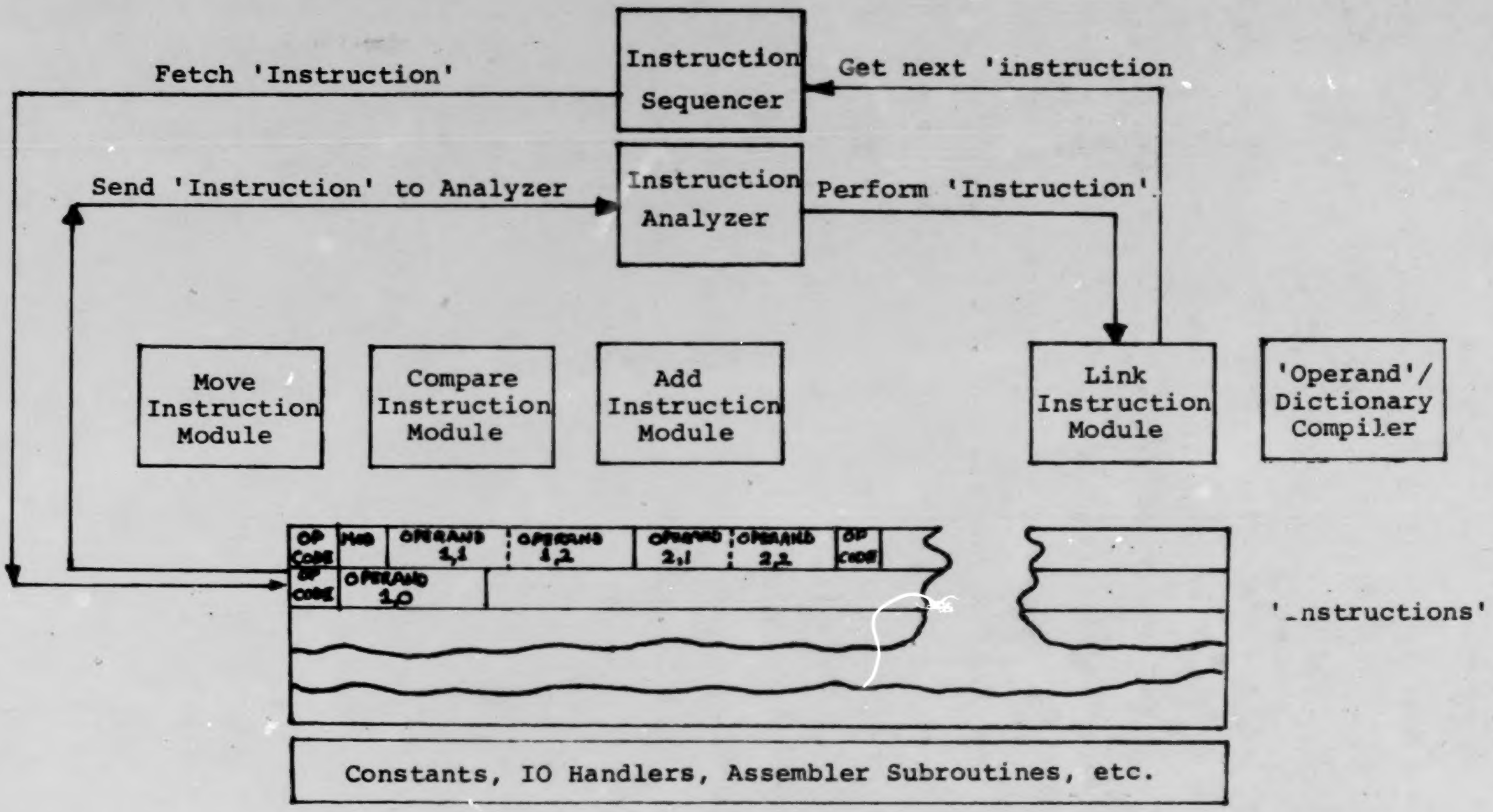
This technique actually requires 're-inventing' the machine (See Figure 4) but on terms which are more acceptable, and allow for far greater control than exists presently. Once designed, this programming - above-programming or 'hyper-programming' - could be used to make the standard compilers which would then inherit the greater flexibility. Because we now can exercise control at the operand level, more than shareability results. Indeed, programs could be written which contained references to data elements not yet recognized on the Data Dictionary. This could have many uses.

First, software could be written in anticipation of the existence of the data. This can be difficult at present, particularly if the new data is to be integrated into an existing report.

Secondly, super-reports could be generated which might contain data-elements meaningful to only one or two institutions within the distributed environment. This is an absolutely necessary facility if shareability is to be achieved, and

Thirdly, additional security can be effected at this level by merely removing the reference to the data element in the local dictionary and then having all unresolved operands flagged-off as inoperable.

Figure 4


Fetch 'Instruction'
Instruction Sequencer
Get next 'instruction
Send 'Instruction' to Analyzer
Instruction Analyzer
Perform 'Instruction'.
Move Instruction Module
Compare Instruction Module
Add Instruction Module
Link Instruction Module
'Operand'/ Dictionary Compiler
OP CODE
MOD
OPERAND 1,1
OPERAND 1,2
OPERAND 2,1
OPERAND 2,2
OP CODE
OP CODE
OPERAND 1,0
'_nstructions'
Constants, IO Handlers, Assembler Subroutines, etc.

A SUGGESTED METHOD OF ACHIEVING SOFTWARE INDEPENDENCE.

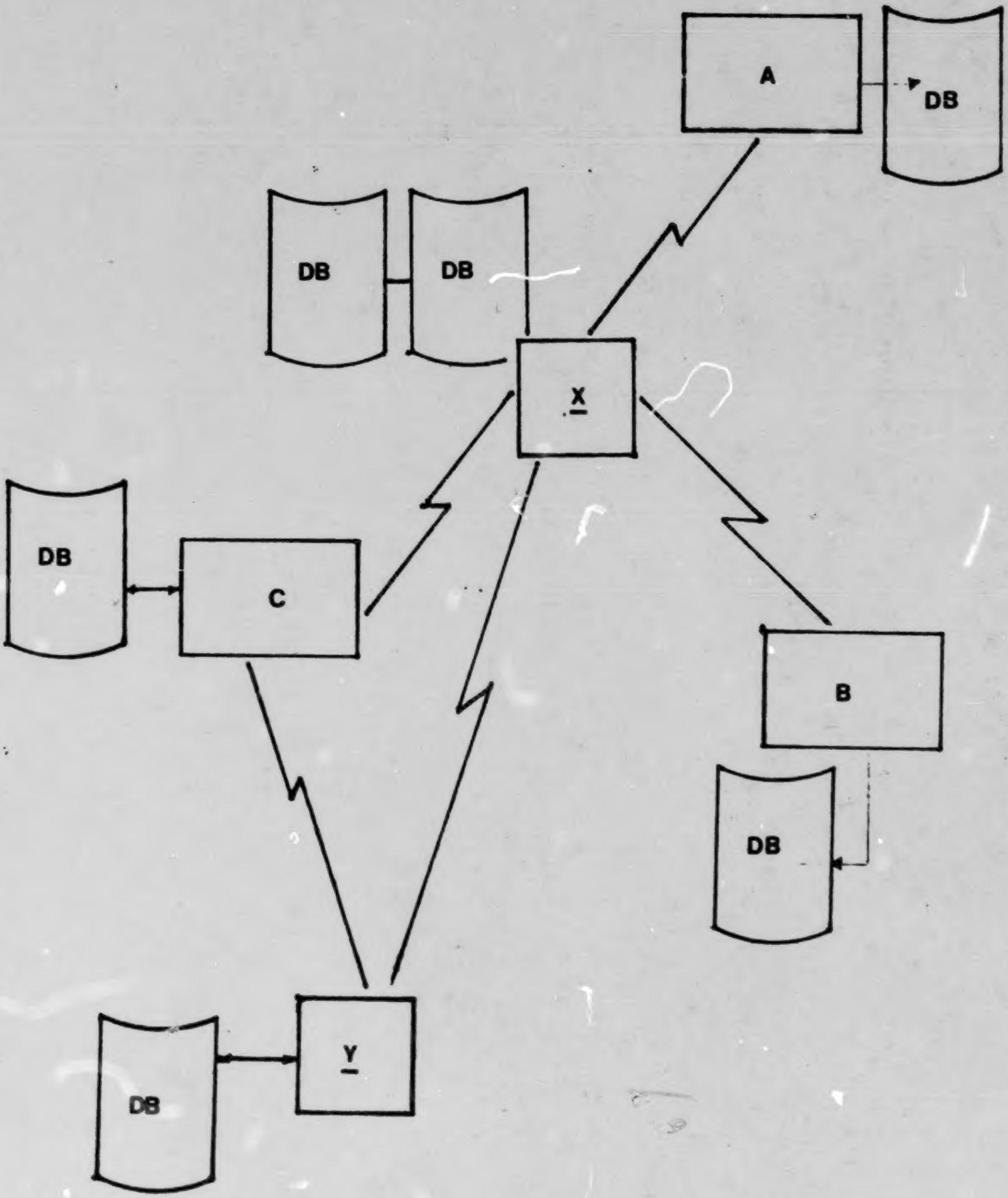
From a software design point of view, this is not startling and in some respects, represents nothing more than the modular concept pushed to its lowest functional limit. The correlative issues of software and data independence have implications which go far beyond just Distributed Data Bases.

It is becoming realized in more and more quarters that software has lagged behind hardware to the point where it threatens to throttle future advances in data processing. In the absence of truly adaptable software and agreement on the physical aspects of data, it probably does little good to try and compel adherence to pre-defined physical standards merely for the sake of having something that one calls 'distributed' data base.

A much more productive approach might be to opt for one of the many smaller database or file management systems so that, on an institutional level at least, a well-structured and rationalized data environment could be achieved at a minimal cost.

Once accomplished, the resulting pattern (structures and data dictionaries) would actually represent the users requirements at that point in time and it would be to this that any Distributed Data Base software would have to address itself at the very least.

Distributed Data Bases are not coming into existence as rapidly as they could because of the factors noted here. Present day DBMS software places much of the work on the user when, in fact, it can and should be performing the work itself. As users come to this realization, they will demand and get software which adapts itself to the user, not the other way around.


A
DB
DB
DB
X
DB
C
B
DB
Y
DB

DISTRIBUTED DATA BASES

THE ROLE OF AN ADMINISTRATIVE DATA PROCESSING UNIT IN A DECENTRALIZED PLANNING PROCESS

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Planning at West Virginia University is a decentralized process wherein each unit annually reviews and updates assumptions regarding its future which are instrumental in future planning and budgeting procedures. In addition, University-wide assumptions are developed which serve as guidelines for funding/non-funding decisions. Many assumptions are based on information maintained in computerized data bases. It is essential, therefore, the information obtained from these data bases be consistent as well as accurate for all units.

This paper describes the evolution of an administrative data processing unit (AIG) which facilitates the standardization of information necessary to support the planning/budgeting process. The initial organization, present status, and future of the AIG will be discussed relative to its role in the University's planning/budgeting process.

Introduction

Today, higher education is faced with ever-increasing demands for more expensive and diversified programs, and has relatively fewer resources available to meet these demands. As a result, academic, facility, and fiscal planning has become an important activity at many institutions. However, it is important not only that planning be done, but also that the resulting plan be an integrated and realistic outline of the institution's future. While the mechanics of planning processes are as varied as are planning processes, those which seem to be most effective are those which blend internal consistency of the institution with relevance to the various units of the institution. In addition, "integrated planning can be achieved only when planning is a regularly scheduled activity which occurs frequently and which produces results that manifest themselves in the allocation, reallocation, and effective uses of resources within the institution."[1]

One such planning process has been developed at West Virginia University. At WVU, integrated planning occurs through decentralized procedures which require input from all unit managers. There is also a planning office whose charge is "to develop, implement, and coordinate the execution of the planning process." As such, the Planning Office is the mechanism by which internal consistency is maintained, while actual planning is accomplished by the individual units insuring relevance between the resulting plans and existing programs.

In essence, the planning process at WVU may be thought of as a two step process. First, each unit develops a set of long range plans (from seven to ten years.) These "Planning Assumptions" conceptually outline the future of the unit. The second phase of the planning process is the annual budgeting procedure. This may be thought of as short range planning wherein the units operationally define the methods to be used in meeting the goals outlined in their long range plan. At WVU then, the planning process drives the budgeting process.

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[1] Raymond M. Haas, "Integrated Academic, Fiscal, and Facilities Planning," Planning for Higher Education, Volume 5, No. 5:2/5, October, 1976.

In order to effectively develop both long and short range plans, much information must be provided to the units. While some of this information comes from in-house sources, the majority is administrative in nature and must come from the University's central administrative files. The administrative units function as unique elements within the administrative structure of the University. As such, they are responsible for both the creation and maintenance of their own files. Because of this situation, the present Computing Services unit was evolved, in part, to facilitate the coordination needed between the various administrative units. (The specific role of the Computing Services unit is outlined below.) In this way, each unit as well as the Planning Office is assured that the data it receives are consistent with the data received by other units.

The Role of the Planning Office

The theory behind the planning process developed at West Virginia University is described by Dr. Raymond M. Haas in Planning for Higher Education,[2] October, 1976. As mentioned above, it is the purpose of the Planning Office to coordinate the planning process, not to be the actual planner. To accomplish this, the role of the Planning Office can be identified in three ways.

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[2] op. cit.

They are:

(1) "To develop a set of planning tools." These tools provide the unit managers with a "common understanding and a common basis for planning." The tools include a statistical summary of the University, forecasts of the University's future, an outline of the responsibilities of specific units and their conceptual as well as their operational objectives, and finally, special studies upon request by the units to the Planning Office. (In particular, the Office of the University Architect, the Office of Facilities Analysis and Utilization, and the Office of Institutional Research carry out these studies.)

(2) "To see that planning gets done." This is done through a comprehensive schedule of planning activities which is distributed to each dean and director at the beginning of the planning process. This scheduled set of events operationally defines the short range planning process.

(3) "To see that planning gets done well." This quality control function is accomplished in two ways. The first is that the planning process is done in a systematic and orderly manner. Secondly, because participants in the planning process must also carry out their plans, the probability of success is greater than if the planners did not have to implement and adhere to the resultant plans.

For more specific details about the role of the Planning Office, see the article cited above. It is obvious, though, that in the development of the planning tools, especially the statistical summary and the special studies, much coordination is needed between the Planning Office and the Computing Services unit. The Computing Services unit is required to supply some of the data for the development of these tools. In this way, the consistency and accuracy of the data is checked at two points before it goes out to the units. It is through this mechanism that the Planning Office supplies the units with information needed for planning.

The Responsibilities of the Unit Managers

As mentioned above, the planning process at West Virginia University is decentralized wherein each unit manager is charged with the planning for his or her own unit. Since the budgeting process is a function of the planning process, the plans developed by the unit managers are realized through the allocation/reallocation of resources. As scheduled by the Planning Office, the units produce a series of planning documents which operationally outline their short range plans. The long range plan of each unit is also developed or updated each year. As the long range plans are conceptual in nature, specific data from administrative files are not needed. The University's long range plan, which is updated yearly, is supplied to the units by the Planning Office. This gives the units insights about the future of the University and enables the units to develop long range plans consistent with those of the University.

As mentioned above, short range planning is manifested in the budgeting process. According to a schedule provided by the Planning Office, the units develop an Operating Budget Request and then an Operating Budget. In essence, the Operating Budget reflects the implementation of plans outlined in the Operating Budget Request. The following is a description of the development of these documents.

The Operating Budget Request is developed and presented to the Budget Team during the summer of the fiscal year before its resulting allocations become effective. In conjunction with the Operating Budget Request, an annual report is submitted. This report is an analysis of the unit's achievements and shortcomings of the previous year. This is usually done in respect to the objectives outlined in the West Virginia University Organization (this is the third planning tool described above.) In addition, specific plans and courses of action for strengthening the unit are recommended. The Operating Budget Requests are priority listings of the unit's needs for each of several funding categories. Each item requested must be justified in light of the unit's long range plan or its objectives as described in the West Virginia University Organization and should be related to the shortcomings addressed in the annual report. Data used in supporting arguments for requests are found in the statistical summary and through special studies requested through the Planning Office. Additional support is received from weekly, monthly, and 13th month reports from the Budget Office. Through these reports, the unit managers are kept up-to-date about the fiscal status of their units. This information also gives the managers insights about spending trends within their units for specific items. This type of information supports requests for increased allocations for specific purposes. Later in the fiscal year (early spring) the unit managers are given the opportunity to revise their Operating Budget Request. All revisions must be made in the same manner as the original requests. (Parenthetically, it is at this time that planning for the next fiscal year begins with revisions of the unit's and University's long range plans.)

The Operating Budget is then prepared by the individual units. Again, this is the document which reflects the implementation of the plan outlined in the Operating Budget Request. This document is prepared in the early summer before the beginning of the fiscal year which it outlines. Data needed to generate the Operating Budget must come from the Budget Team and is concerned with the level of support to be given the individual unit's requests.

The above then is a description of the planning process at WVU and the data needed to support it. It is critically important in this decentralized planning process that consistent and accurate data be supplied to the various units involved in the planning process. In order to supply the various components that make up WVU with needed data, a Computing Services unit has evolved. This unit is relatively new at WVU, has already gone through several organizational changes, and is expected to go through several more. Described below is the evolution of the unit to its present state. In addition, the unit's proposed future structure is described.

The Evolution of Computing Services at West Virginia University

A number of factors found in all large administrative organizations led to the creation of an administrative data processing unit at WVU. The primary factors were the need for consistent data and reports and the volume of data to be processed. At this point, additional history should be introduced to give the reader proper perspective.

For a number of years, beginning about 1973, the governing body of the higher education system in West Virginia, the Board of Regents, suggested the need for increased computing capacity throughout the state. The initial budgetary considerations increased the computing capacity at the "other" state supported schools throughout the state by adding communications hardware and lines to WVU's computer system and installing an upgraded communications controller at WVU. Thus, the door was opened for expansion of service to these schools through availability of WVU's large computer. Subsequent additions of disk drives and finally an additional computer evolved into the West Virginia Network for Educational Telecomputing (WVNET).

For some time, West Virginia University and WVNET shared a building, a director, computer hardware, in addition to support staff. The old WVU Computer Center had an Administrative Services staff which, under an assistant director, performed the software development and maintenance for all WVU administrative units, e.g. comptroller, budget, personnel, etc.

Since there was a very diverse user community, most major departments also had staff of their own. There was a Data Entry section attached to the Computer Center as well as a staff of expeditors. Some were employed by the Computer Center and others by the Comptroller.

It became apparent that there was little consistency and/or control between development by the Computer Center staff and the other administrative units. Therefore, in the summer of 1976 the Provost for Finance began to assemble the necessary staff to produce accurate, consistent reports and files. The new group was called the Administrative Information Group (AIG). This group was made up of the following staff:

Comptroller's Office

1 - Data Processing Supervisor
1 - Lead EDP Technician (expediter)
4 - EDP Technicians
3 - Verifier operators
6 - Keypunch operators
1 - Data Preparation Technician
1 - Senior Systems Analyst

Computer Center

1 - Assistant Director
2 - Senior Systems Analysts
1 - Systems Analyst
6 - Senior Programmers
4 - Programmers
1 - Secretary

Physical Plant

1 - Systems Analyst

Admissions and Records

1 - Systems Analyst

President's Office

1- EDP Technician
1 - Senior Programmer

Budget Office

1 - Senior Systems Analyst

Including part-time positions, not noted above, 38.85 FTE positions were combined, with a corresponding total annual salary of $382,027.

Once assembled, the primary function of the new group was to construct, modify, and run programs and systems to process administrative information. The staff of the new unit needed a great deal of coordination in its formative months. Therefore, an experienced data processor, one of the University's auditors was given the position of Unit Coordinator.

As the group began to take shape, this individual was released back to his original function, and control of the group was given to the associate provost for finance. The day-to-day operation was left to one of the senior systems analysts. The group functioned in this way for a number of months. In May of 1977, a new Unit Coordinator was appointed.

During its birth, the two primary goals of the AIG were to (1) produce daily management reports on both financial and student records information, and (2) perform major and minor system development and maintenance in an organized manner. One of the major functions of the AIG was and is to see that the needs of all the administrative units are met with due regard to the deadlines and priorities of each. 63

The consolidation of all these staff allowed for an additional benefit. Since most offices have cycles of busy and slack times, and since all have different cycles, a smoothing effect of shared staff allowed for more work to be done through more efficient use of staff. A great deal of additional efficiency was obtained through the sharing of knowledge and experience.

Some units at WVU still maintained their own staff, as they felt they could best be served in that manner. A number of problems have arisen because of these dedicated staff members. For example, a file may be used by many offices, but be the responsibility of only one. If the responsible office decides to change the format or omit some information, etc., the file may become unusable by another office.

An even worse problem is that of multiple interpretations. As an example, suppose Admissions and Records reports a total of 6,000 new students in the fall semester of 1977. The Office of Institutional Research might report 4,500 new students from the same files. There could be a number of explanations for such discrepancies. First, Admissions and Records might be reporting all students who were not on the Spring 1977 files. Institutional Research might only report students who had never taken classes at West Virginia University. To further complicate matters, the question of on-campus versus on-campus plus extension students might be a factor. This type of problem is extremely common.

The problem expands as we look into financial data. For example, three offices, Budget, Comptroller, and Purchasing all process requisitions, expenditures, etc. All have some impact on or are impacted by the budget and ledger files. The coordination of processing is absolutely necessary. If the offices were to get the wrong versions of each other's files, the results might be some expenditures never getting posted to the ledgers, an old budget file allowing expenditures which exceed the current budget balance, etc. The problems increase exponentially with the number of offices involved in the origin and disposition of the information.

To continue the history of the development of the AIG, in February of 1977, the West Virginia University/WVNET Computer Center officially split. Two directors were defined. The WVNET director reported to the Board of Regents while the West Virginia University director remained non-existant. The AIG remained under the Provost for Finance and the Supporting Services (operations, student consulting, etc.) became responsible to the Computer Science Department. In August of 1977, a Director of Computing Services was appointed. The Director was moved under the Provost for Planning and both AIG and Supporting Services were assembled under this Director.

The academic versus administrative attitude was dissolved and the concepts of a separate Development Section and a well defined Dedicated Resources (people and/or equipment belonging to non-Computing Services units) structure were established.

Present and Future Computing Services at West Virginia University

The Computing Services unit, in general, functions as most other computer support groups. There are, by definition, two major deviations from the classic organization. The first is the concept of "dedicated resources." Dedicated resources are computer personnel or computer hardware, funded by a unit other than Computing Services. A more detailed explanation of the dedicated resources concept is included in the discussion of the independent development section.

The second deviation from the classic organization is an independent development section. In most computer support units there are subunits responsible for: data entry, operations, expediting, new development, and program or system maintenance. Computing Services has been defined to have all the above subunits, except that only minor new development is done by Computing Services. Major development is done by an independent development unit which reports directly to the Provost for Planning.

The utilization of this development section is defined in a rather innovative way, at least for computer support staff. Since, at West Virginia University, and most other places, systems and program development staff are in short supply, and since there are many diverse applications from many different University units, priorities become a major problem. The Provost for Planning has resolved this problem in the same manner that priority problems for other service units are handled.

At West Virginia University, priorities and/or allocation of resources (of which systems development is one) are established by the University's budget team. This team is made up of the University's Provosts and the Executive Officer, i.e., major line officers of the University. Just as expenditures for repairs and alterations operations, new personnel, etc., are planned and budgeted, expenditures for computer systems development must also be planned and budgeted. The following procedures have evolved to the definition stage, but have not actually been exercised. The first actual implementation of the new scheme should be in the Spring of 1978.

In the new scheme, the "dedicated resources" concept takes care of new major systems development. Dedicated resources, as stated above, are those assigned to non-Computing Services units. They are dedicated to projects which benefit the funding unit. At the option of the Dean or Director of the funding unit, the day-to-day supervision of the dedicated resource may be assigned to the Director of Computing Services (or his representative). The funding unit would then contract with Computing Services for completion of a set of goals. Computing Services would then direct the dedicated resource to the completion of the goals. This allows a unit wishing to give systems development a high priority the opportunity to insure the funds are spent to its benefit, but does not require the unit to duplicate the expensive management required for computer personnel. This eliminates potential problems which may arise with new or inexperienced management. In this budgeting process, the budget team decides the relative priorities to be assigned to major systems. It then determines if the work should be done by dedicated resources in the requesting unit or by the development unit. As a follow-up, the concept also requires the funding unit to report the suggested projects to Computing Services, even if the supervision of the dedicated resource is not assigned to Computing Services. The reporting mechanism insures one of the primary needs in a decentralized planning organization. That need is for accurate, consistent information. As long as one unit coordinates all systems development and modification, the University can be assured that independent data bases, etc., will not be established which could introduce differences in data for the same logical sources of information. This coordination is a must when independent units must make independent decisions, and later have their decisions (or requests) combined to construct a University-wide perspective. If units have differing information about the same subject, their analysis cannot lead to planning assumptions which are internally consistent.

The independent development group will act as a dedicated resource. University units will make annual systems development requests to the University administration. The requests will be reviewed by the budget team. Projects will be selected and a total resource to be allocated will be defined (total FTE positions for major systems development). These projects will be scheduled, and the remaining projects will be returned as unfunded. If the requesting unit has funds for its own dedicated resource (and if the budget team approves), it may wish to begin an unfunded project with its own personnel.

Once all priorities have been set, the Director of Computing Services will be assigned the number of FTE positions allocated by the budget team, as well as the selected projects. The director will then be responsible for the completion of the projects.

If a unit determines a crisis need during the year which it feels cannot wait until the next review period, it may request a special hearing for its problem. If the budget team determines that this project must be done, it will determine which previously approved project or projects must be cancelled. This procedure eliminates the most serious problem in all computing operations, the over-commitment of manpower. When manpower is over-committed, the net result is insufficient design, testing, and documentation. These deficiencies lead to systems which require constant maintenance, and which are very difficult to support.

In all, the dedicated resources reporting mechanism is mandatory if consistent data are to be produced. The independent development group also insures the FTE positions to be spent on major systems development. Treating the development group as a dedicated resource insures that the University administration gets the development done that it feels appropriate, and that this development remains consistent with existing systems and the general plan for future data processing. These two concepts, together with the centralized day-to-day data processing, insure that consistent data is available to decentralized planning units.

Summary

At West Virginia University, planning is a decentralized process which must result in an internally consistent plan for the institution. Relevance to the individual units is maintained as long range unit plans are manifested in the annual Operating Budget (the result of the short range planning process.) In order that all units' plans are consistent with the master budget and long range goals of the University as a whole, the information used in the planning process must be uniform for all units. The only viable approach to guaranteeing uniform and timely information is to have it produced through a central facility.

A central facility (Computer Services) has evolved at West Virginia University. This unit is much like comparable units at other institutions except that major systems development is handled in a unique way. Systems development is considered a resource and is treated in the same manner as other resources, i.e., via allocation/reallocation. This procedure helps to insure that University as well as unit goals are met. As at West Virginia University and other institutions, adequate computer staff are not available. This process insures that development is given proper priority relative to production and maintenance. It is the budget team at West Virginia University that sets the priorities and provides funding as it is their responsibility to allocate resources in ways consistent with the long and short range goals of the University.

THINKING NEW SYSTEM(S)? SOME ACTION ITEMS

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The planning for, design and implementation of information management systems in colleges and universities is approaching a state of adolescence as a science. Because we cannot devise "rules" with sufficient scope and depth to cover all institutional and systems contingencies, the necessary activities remain somewhere between magic and art. At least ten "things" can and should be done in the early stages of systems planning. These relate to facilities management, a systems committee, the user liaison functions, seminars, data base management, advisory committees, implementation task groups, a procedures committee, user training, and evaluations.

PART I

PERSPECTIVE: FOCUSING ON THE TARGET

PEPPERDINE UNIVERSITY

Pepperdine University was established in 1937 through the philanthropy of George Pepperdine (1886-1962), founder and developer of the Western Auto Supply Company. The school was primarily an undergraduate college, affiliated with the Churches of Christ and dedicated to promoting liberal arts education with a Christian atmosphere.

The school opened as Pepperdine College on the 35-acre original site in south-central Los Angeles, with 137 students. A grant by the founder provided for the campus, buildings, and an endowment of approximately two million dollars.

An enormous growth period ensued in the late 1960's and early 1970's (see Figures 1 and 2) as Pepperdine rapidly expanded from a single undergraduate institution to a multi-campused operation of five schools and many off-campus locations.

In 1972, the 650-acre Malibu Campus, site of Frank R. Seaver College, opened with 872 students. As of the current school year, 1977-78, Pepperdine Schools of Professional Studies, Business and Management, and Education are administered from the Los Angeles Campus. Pepperdine School of Law, presently located in Anaheim, will be joining Frank R. Seaver College, the traditional 4-year undergraduate college at the Malibu Campus, in September, 1978.

Adding complexity to this phenomenal growth are off-campus teaching locations, weekend mode courses, multi-disciplinary courses, a one-year

European program and extensive military programs on a world-wide basis.

The challenges which must be met due to this rate of change are most evident in the areas of Student and Financial Records. As the technical needs of the systems change, so is it necessary to restructure and redefine the procedures and functions that the staff have been working with in the past, a task at least as important as the technical modifications.

UNIVERSITY INFORMATION SERVICES

The coordination of such extensive administrative changes involving computer systems became the responsibility of University Information Services (UIS). UIS was originated for the purpose of developing a Managament Information System rather than a data processing operation in order that overall administrative/academic needs could be met in a unified way, and future planning and information reporting could be correlated with the current data processing done in support of the administrative systems. In effect, UIS has become a change agent for the University in the sophistication and refining of Pepperdine's systems requirements.

UIS has two primary objectives: (1) to provide management information to all divisions and administrative levels of the University, including information pertaining to decision-making needs and information related to operation of administrative systems; and (2) to provide technical expertise for the design, implementation, operation, and ongoing maintenance of systems software and hardware, both administrative and academic.

Organizationally, UIS reports directly to the Executive Vice President, the chief operations officer for Pepperdine University (see Attachment A). The organization itself is headed by the Executive Director who has direct oversight of the Administrative Staff, Institutional Research, and Computer Services units (see Attachment B, page 1).

Several dramatic occurrences within a relatively short time frame have had a large impact on the University. These included: purchase and installation of a major computing device (a Univac 90/60 computer); design and construction of a facility to house the computer and staff (a two-story, 7,000 square foot building); conversion of some programs and all data from the external Service Bureaus which had been used for Administrative Services prior to the Univac 90/60; performance of ongoing routine reporting functions; and hiring, integrating, and training personnel to support an internal computing facility.

Total redesign and new programming effort for all administrative software has been started. The Integrated Student Information System (ISIS) has been completed. Other primary administrative software such as the Integrated Business Information System (IBIS) are in the initial design stage. Building a research data base for trend analysis from past and current information is also in progress.

The change process is dramatically affected by the organizational management style. In fact, the change strategy may be dictated by it. The approach to management in UIS is derived from a revisionist theory social systems model: specifically, UIS's Executive Director's modified version of the Getzels-Guba "Nomothethic-Idiographic" model.[1]

This model stresses: (1) the group as the basic organizational unit; (2) a well-defined formal structure supplemented by informal communication channels; (3) authority derived from knowledge, skill and achievement whenever possible; (4) control and feedback closely related to group processes; (5) decision-making conducted at the most appropriate level; (6) goal-setting with as much group participation as possible; (7) communication vertically and horizontally occurring without filtering; (8) motivation directly related to the individual's role definition; (9) a project approach to problem-solving; and (10) an atmosphere receptive to internal change.

The strategy being implemented by UIS is a normative-re-educative model very similar to the problem-solving construct described by Novotney[2] with the introduction of a semi-permanent outside/inside change agent.

PART 2

FACILITY MANAGEMENT: INTEGRATION WITH EXISTING ORGANIZATIONS

SYSTEMS & COMPUTER TECHNOLOGY CORPORATION

The outside change agent is Systems & Computer Technology Corporation (SCT), a facilities management/educational software firm with extensive experience spanning ten years in more than one hundred colleges and universities.

SCT has a five-year contract with Pepperdine to provide management and technical expertise in the Computer Services areas of Computer Operations, Administrative Systems and Academic Computing. Managers of these areas report directly to the Director of Computer Services. The Assistant Director immediately supervises Administrative Systems which is comprised of Student Records, Financial Records and User Liaison. All managers of these units are SCT employees. Successive positions are held by both Pepperdine and SCT personnel (see Attachment B, pages 2-4).

SCT personnel work to identify University needs, to provide certain technical skills to the University, to train University staff, to provide support for training, to arrange access to other training resources, to coordinate administration and training as part of the system's problem-solving procedures, to act as a solution giver, to act as a process helper, and to act as a catalyst. The roles vary depending upon direction from the University.[3]

All SCT activities are under the direct supervision of the UIS Executive Director who coordinates their efforts with University personnel to produce concise problem statements, to analyze problems, to form objectives to solve problems, to conduct an inventory of the necessary resources to solve identified problems, to develop plans which will allow objectives to be reached, to help in the evaluation process during implementation and in the determination of how well objectives were met, and to bring about any alterations dictated by the evaluative feedback.[4]

INTEGRATION OF SCT INTO UIS

The functions of the inside agent(s) (the UIS Executive Director and his staff) are critical in seeing that changes brought about by the "outside" impetus become a stable part of the ongoing operation and that they have a broad base of acceptance. Thus, the first task was to integrate SCT management and new Pepperdine employees into the UIS organization. Several actions were specified to take place in this endeavor: (1) the UIS Executive Director interviewed and approved all SCT managers prior to their assignment to Pepperdine. (2) Each Pepperdine employee transferred to UIS was given an individual and a group orientation to the goals and expectations of UIS. (3) The SCT managers conducted individual and group orientations with the unit they supervised. (4) Detailed job descriptions and specific individual assignments were distributed and discussed with all new employees and with UIS employees who reported to SCT management. (5) An all-day complete staff UIS orientation session was conducted. (6) A weekly meeting in which all UIS managers report plans and project progress to the Executive Director was established. (7) An ombudsperson position reporting to the Executive Director was established. (8) An employee's orientation manual describing UIS goals, policy and procedures, organizational structure, the SCT role, and the UIS/University relationship was prepared and distributed to each UIS employee. (9) Meetings were scheduled and conducted with deans and representatives from each school in the University to define and discuss the new UIS role and the SCT involvement in it. (10) Similar meetings were held with all administrative units. (11) Several committees (which will be discussed in detail later) were appointed in an attempt to ensure university-wide input and to facilitate information dissemination. (12) The policy of weekly meetings to discuss schedules, problems or modifications with major systems users was continued. Finally, (13) a monthly meeting where the Director of Computer Services presents a formal progress report to the Systems Committee (the policy-making body for UIS) was established.

PART 3

A SYSTEMS COMMITTEE: COMPOSITION AND CHARGE

Ensuring that UIS meets the objectives for which the department was created, the President of the University has established the Pepperdine University Systems Committee with the following make-up and charge:

> The Pepperdine University Systems Committee is composed of the Executive Vice President, who serves as Chairperson, the Senior Vice President, the Vice

> President of Academic Affairs, the Vice President of Administrative Affairs, the Vice President of Financial Affairs, the Vice President of University Affairs, the Vice President and Dean of the School of Business and Management, the Associate Vice President of Finance, the Controller, the Dean of Student Records, the Executive Director of University Information Services, and the Director of Computer Services (ex-officio). The function of the Committee is to serve as the "policy board" for computer services.
>
> The activities include the establishment and review of all policies related to University computing, the establishment and broad review of University priorities and service levels relative to computing, regular monitoring of the ongoing project to assure effective implementation of the objectives as set forth in the contract, the working plan, and any other systems-related plans of the University, and yearly review of the Computer Center budget consistent with the service levels established."[6]

The committee has a standing monthly meeting but currently meets on an as-needed basis, almost weekly.

PART 4

USER LIAISON: THE COMMUNITY CONTACT REPRESENTATIVE

User Liaison Specialists within UIS are vitally important, having as their prime function the task of facilitating communication between user departments and the computer production and design staff. Each specialist is assigned responsibility for an administrative area and spends most of his/her time in the specific area gathering or giving information and trouble shooting apparent problems.

The UL Specialists who operate within Computer Services have been heavily involved in the design and implementation stages of ISIS. Specifically, UL Specialists assist in procedure writing, forms design, data input screen design and testing and development of data file conversion specifications and associated testing. These functions have been especially important in interfacing with the field engineer for the data entry device and with the data entry supervisor during transition periods. For example, if forms were mailed to students which became obsolete before all were returned, a workable solution would have to be devised to allow input of data from both old and new versions of the form; this impacts system modifications, procedures, and input screen design.

At the same time UL Specialists interpret to the users how the system can best serve them by identifying potential problem areas of design or procedures, such as registration and billing methods for classes with irregular beginning and ending dates. They assist in developing the user's objectives, the design of new formats and the enumeration and clarification of required testing.

As a highly user-oriented group, they have had a primary role in providing training in new data collection and recording procedures to selected personnel. To do this, UL Specialists must know and understand the mechanics of the old systems in addition to the design of the new system. Further, they must know the strengths and weaknesses of their users--and help reluctant users to realize benefits of coordination and systemization. The day-to-day and person-to-person contact given by User Liaison throughout the University community cannot be overemphasized in the process of developing and maintaining a smooth and effective system.

PART 5

SYSTEMS SEMINARS: THE CORE PROBLEM ATTITUDES

Because of the absolute necessity for user involvement in the implementation phase of the new system and because of the substantial unrest and resistance to such a change causing effort, there was a need for some method of bringing about unified feeling of cooperation.

Argyris has stated that "most individuals are 'systematically blind' to their behavior and are therefore 'culturally programmed' to behave in ways that reduce the probability of change."[7]

The device chosen to overcome this "systematic blindness" was a consciousness-raising model developed by Samuel A. Culbert as described in his book, The Organization Trap and How to Get Out of It.[8]

The consciousness-raising model focuses on two components, the personal and the system. The personal component strives to develop sufficient understanding of who we are without our adaptations to the system and to recognize which parts of the system fail to fit our needs. The system component involves our seeing what the system is and how it works--as contrasted with how we've been conditioned to see it--and our thinking about the well-being of others who are also part of the system.[9] In implementing the model, it was important to observe the following points: (see Attachment C)

1. The outputs of each stage provide inputs for the next; thus, the stages must be carried out in sequence.
2. The groups should be carefully selected so that there is a cross section of individuals at the same operational level but representing different departments within Pepperdine.
3. The group should be small enough for comfortable sharing but large enough to construct an accurate perspective of the system (12-15).
4. The group should be committed to attend all three four-hour sessions which meet weekly for three weeks.
5. Each session is to be conducted by a Facilitator who sets an atmosphere of open communication. An individual from UIS, who is a systems specialist, should also be a member of the group for the three weeks. His/her role is to supply answers should any pertinent systems-related questions of a technical nature need clarification.

6. Each seminar should be evaluated for each session both by the attendees (see Attachment D) and by the Facilitator (see Attachment E). These evaluations are then tabulated and analyzed.

Ideas and alternatives for changes to the system--be it administrative or computer-based--were drafted by each seminar group in the form of Action Items which were directed to University officials. General areas of concern have been communication, quality of management, fringe benefits, university-planning, management philosophy, software design, and data processing operations.

Examples of the responses to such recommendations were: a trimesterly meeting with top university administrators and the staffs of each campus in a report/question/answer format; increased benefits to personnel; better management direction; improved coordination and communication between departments; additional training sessions; clarification of roles within the institution; an orientation manual to UIS for non-UIS personnel; wide distribution of the University organizational chart; etc.

PART 6

THE DATA BASE ADMINISTRATOR CONCEPT: DEFINITION AND SCOPE

The Data Base Administrator (DBA/DBM-Manager) and various views and roles of the position were described in an article[10] in the May, 1977 issue of DATAMATION, entitled "The Many Faces of the DBA." The consistent theme of the article is there's no consistency in the position, either from the standpoint of qualifications, of salary, of place in the hierarchy, or of employer expectations. That's consistent with several other positions we could name.

If there's a single knot that ties the individuals in the data users community to the information they require for effective operations, it's probably the DBA. The DBA is to corporate data and information what the Director of Personnel is to the employer/employee relationship in an organization. He or she must have an understanding of the organization's goals, of the information needs associated with each of the sometimes diverse units comprising the organization, of the level of sophistication the users will bring to an EDP-managed environment, and must have a sufficient depth of knowledge of the limitations and capabilities of the specific data processing resources provided by the institution to work with systems programmers in development of a realistic systems design in the context of these parameters. The analogy with a Director of Personnel rests on the assumption that the Director must have a similar knowledge of the personnel needs in an organization, be able to systematically quantify and keep records accordingly, and know where, how, and what time frames are necessary to meet these needs.

As we perceive it, the human characteristics one looks for in filling a DBA position include not only an intimate general knowledge of institutions of higher education from a broad philosophical to a nuts-and-bolts perspective, but also these:

1. Administrative--We associate these with common sense planning which includes future growth, policy needs, and resources, planning for an organization with adequate (not surplus, not deficit) human, fiscal, and physical resources;
2. Technical--A grasp of the state-of-the-art picture in both the changing technological environment and in terms of where colleges and universities might be five years from now. This means changes precipitated by state and federal government requirements, changing curriculum and student populations, changing emphasis on data as an institutional resource, etc.;
3. Managerial--Speaks to one's ability to assess accurately what one has to work with and optimizing the utilization of those resources to meet today's needs. Good procedures and training programs accompany a good manager; and

4. Attitudinal--We don't suppose there are more than a dozen DBA's in colleges and universities across the United States with as much as ten years experience in their position. How does the DBA view himself/herself and how are they viewed by their employer? In the absence of a clearly defined and mutually acceptable role in the profession, how many quality DBAs will we have ten years from now? Business more and more views Data Base Administration as a profession, but, given the high-powered language we use to define a professional, we doubt that more than 5-10 percent of the 3,000 plus colleges and universities in the United States have a professional DBA. You in this room will have a significant impact on answers related to these questions between now and, say, 1980, and our attitudes and self-image will reflect your answers.

We have a handout (Attachment F) outlining the generalized job description employed by Pepperdine University for its two DBAs. One DBA for the Integrated Student Information System, and one for the Integrated Business Information System. If these two DBAs do a workmanlike job in data base development, likely a single DBA, working with two managers, (at a considerable lower level) is all that will be required to get our job done on a maintenance basis.

While most of what we've said about the DBA has been gained from direct experience over the past 15-18 months at Pepperdine University, some of it was learned by us too late to put into optimal practice.

PART 7

ADVISORY COMMITTEES: THE INPUT FRAMEWORK

Under the leadership of the DBA and with input from all chief administrative officers of the University, total user office representation was sought at the initiation of data base planning and design. Some 18 different offices have representatives on our Student Systems Advisory Committee, and approximately the same number sit on the Business Systems Advisory Committee. We consider the benefits derived from the Committees of inestimable value to the success of our systems development for the following reasons:

1. They established a spirit of "community" effort and input leading to a sense of "ourness" about the system which was developed;
2. Systems oversights were caught prior to being formally incorporated in the design;
3. It was easy to identify and develop "worst case" examples in the design and testing of systems flexibility;
4. Since our programs are systems tables monitored, adequate field sizes were established in the tables on the first pass; and
5. There has been almost no negative kick-back in the form of "our office didn't know/wasn't informed in time to fully assess our needs."

A couple of additional insights accompanied this participatory development plan. First, things went a hundred times better when we (the DBAs) came to the Committee with a specific proposal for each segment of the system. It is much more efficient to change a proposal than to try to develop one in a committee environment. We tried to have each proposal and a meeting agenda in the hands of the Student Systems Committee members at least ten days prior to meetings. In this manner, each member could review with and solicit input from those (s)he represented. Also, each meeting was followed by minutes, kept and distributed by the chairperson. Meetings were held every three-to-six weeks during the system design. A second important advantage was gained when it was time to start user training programs, which is covered in more detail later. Having individuals in the training sessions who already had a good overview of the system we were installing (from having had Advisory Committee experience) permitted a much more effective user training series than we could otherwise have expected. Thirdly, we introduced a system that already had a fairly broad base of support on the day of start-up.

In summary, the Advisory Committees provide valuable early input for systems design and review and, just as importantly, provide effective channels for communication in an area where the importance of communication is indispensible and too often overlooked.

PART 8

IMPLEMENTATION TASK GROUPS: A MIDDLE MANAGEMENT ROLE

Several weeks following the wrap-up of our data element dictionary definitions, systems tables identification, and program specifications, it became obvious there was no orchestrated effort to get user-initiated tasks off the ground. Everybody seemed to be working hard but we did not appear to be making any systematic progress towards day one of implementation. The following events and descriptions apply only to the student system segment of our systems development, although it likely will be the case for the business system (if we haven't made it clear, these systems are integrated and accessed using common retrieval software).

It was the circumstances just described that led to the formation of the student system Implementation Task Force. It is composed of the Dean of Student Records, our two registrars, our two assistant registrars for data management, and the Manager of Student Records Systems from University Information Services. For some four months, we met formally once a week following-up and following through with mutually agreed upon tasks and priorities. Beginning with the system start-up and the opening of the Fall Term, these meetings have been reduced to twice monthly. Here, in general terms is how our time was spent.

Initially, the meetings were devoted to formulating strategy: what to do first and how, what followed, etc., on through to the final tasks. Gant charts were constructed for each segment or module of the software. Our first stage development plan called for two transaction editing modules; a Transactional Input Module, for macro screening; and Systems Tables, used wherever possible, as appropriate. The action files and/or programs defined for early use were: Course Catalog, Course Schedule, Drop/Add, (which handles all our registrations), Student Billing, Data Base, Grades Reporting, and Reporting/Retrieval. To these we are presently adding modules to manage our admissions/marketing programs, financial aids, institutional research, and alumni/development. In general, the plan we developed for user activities can be applied to any of these (and perhaps to most other modules.) The activities engaged in consist of five broad categories:

1. Input Form design and Production Activities;
2. Table Definition and Construction Activities;
3. Production-related (through to report retention) Activities;
4. File Conversion(s), where applicable; and
5. Testing (which includes procedures and retrieval request development).

(see Attachment G).

Since the programs mentioned were brought up as a working system, the Implementation Task Force has met twice monthly to refine procedures, to evaluate our own and other users satisfactions, and to begin to identify and prioritize needed refinements. These sessions aren't nearly as frantic or productive as our earlier meetings but, we feel, are just as desirable in the overall scheme of things.

PART 9

THE PROCEDURES COMMITTEE: PERFORMERS, REVIEWERS, CONSULTANTS AND APPROVERS

When we talk about a system, new or otherwise, we are aware that a large number of developed and accepted procedures are necessary to make the system successful. With this in mind, we identified the functions we anticipated the nucleus of the student system would serve; then, using key personnel from the Student System Advisory Committee, we began itemizing the needed procedures. Simultaneously, the concept and constitution of a Procedures Committee was outlined and a charge written. The listing of needed procedures collected from our users was organized around the associated software elements and put into a sort of matrix (see sample page Attachment H), with individuals and/or offices comprising the columns and the procedure naming the rows. It was decided that each procedure to be written would require four types of input:

1. Performance (writing),
2. Consulting,
3. Reviewing, and
4. Approval.

Counting up the needed procedures identified with the nine student systems modules described earlier (under Part 8, Implementation Task Groups), we found there were more than 100. This effort, started about April 1977, reached a milestone in late summer--a draft of each needed procedure! These drafts have been written with input from designated consultants, reviewed with major users impacted, and approved by the appropriate individual or office. Using our experiences through the first full cycle of running student systems, the procedures will be (indeed, are now being) refined and polished. Some side benefits from having this Committee with its charge are:

1. A much better educated and more aware user community;
2. A broader sensitivity on the part of users as to the overlapping and interrelated nature of procedures; and
3. User/Committee initiated input as to policy areas not adequately defined/enforced. We feel this latter characteristic is strongly indicative of the type of system user group that will maximally serve our student and University publics and also indicative of a transition from a group of systems-naive individuals to one of educated systems users. We believe this has been a major step in the right direction.

PART 10

TRAINING: APPROACH TO THE REAL PAYOFF

Despite the fact we thought our approach to a user training program was sufficiently well thought out and that oversights would be nonexistent, hindsight has somewhat modified that view. Starting with what we actually did, we will come back to a couple of areas we probably could have better managed.

Eight considerations or stances were used as the training model design.

1. Identification of Target Population--Starting with a listing of every administrative and academic office, we went module-by-module through the student system software, recording for each module the offices that would impact or be impacted by the referenced data flow. The chief administrator in each of these offices was asked to name a representative (more than one in some cases) who would be available for the training series.
2. Calendar--We scheduled an every Wednesday morning, 8:30--12:00 noon, training session that spanned about three calendar months. This calendar was circulated well in advance to every identified participant with each session the recipient was

expected to attend highlighted.

3. Sequence--The schedule of presentations began with the first module in the student system program stream, in our case the Transaction Input Module, then went to Systems Tables, to Catalog, Schedule, etc., through Grade Reporting and finally Retrieval.

4. Group Size--Initially we thought we could hold the groups to between 12-18 members--much to our dismay some of the sessions, especially the general introductory sessions had up to 40 individuals.

5. Leader Consistency--We decided early on, and later were glad we had, to use the same individual for the training leadership role (teacher) throughout the training program. This minimized the time loss we would have encountered due to user readjustment to teaching style and also eliminated continuity gaps we might have experienced using several leaders.

6. Resource Availability--Every effort was made to insure the user manuals, input forms, program testing materials, and of course software, were all on hand at the time we introduced each new module. In the case or two when this was not possible, time wasting was prevalent and morale damaged. Fortunately, these were exceptions to the rule and not of much consequence overall, but this would have been crippling had it been routinely the case.

7. Format--We used what might be called a general information session (GIS) to introduce each new student systems module. Every office identified as a user was invited to be represented for these overview presentations. These were followed by two or three detailed information sessions (DIS) wherein user training was provided in a learn-by-doing/using environment. We strongly endorse this approach to the practical aspects of training which, incidentally, also served as early stage testing of the software (since we exercised the live data).

8. Homework--For every hour spent in the formal training environment, at least an equal amount of time was required between sessions. Documentation was read, test data collected, and questions submitted prior to the session in which the materials were formally covered. This required a considerable time commitment from each participant, but we think would have consumed even more time had we attempted to do everything in a group meeting. Not doing homework was considered the worst sin the users committed.

PART 11

EVALUATION AND CONCLUSIONS: HOW ARE WE DOING?

This segment of our presentation gets at the meat of the conference theme: Are expectations equal to reality? In looking for answers to the question, we must confess at once to the subjectivity of the assessment. The finished products do reflect those characteristics initially specified, and that is the beginning and end of an objective assessment. Many would say, and perhaps justifiably so, there is nothing else to examine. This of course assumes the absence of human frailities and personalities as well as a freezing of the clock. At this time the reports produced have been in the hands of users too short a period (three months) to allow for a comprehensive assessment. Data which the users are accustomed to receiving are still provided but now are subject to new manipulative capabilities. There are scattered complaints from the secondary user community regarding added data collection and auditing requirements; such comments as "I spend more hours working for the Admissions Office/Registrar than for my own office" are not uncommon (or unexpected).

If we judge the training efforts according to the success of users in exercising the system, then with one or two exceptions, this area would get high marks--about eight on a scale of ten, objectively.

There are offices and individuals in our University experiencing some disappointment because they unrealistically expected more for less, and in those cases expectations are not equal to the achieved reality. We believe this reality gap is in direct proportion to the level of understanding and sophistication of those offices and individuals, and do have, relative to college and university systems specifically, and to machine records keeping capabilities generally.

We thought we specified a student information system that would allow us to efficiently and effectively create and manage student records information; at this point, there does not appear to be any reason to think the system will not do just that.

FOOTNOTES

[1] Carver, Fred D. and Sergiovanni, Thomas J., Organizations and Human Behavior: Focus on Schools, McGraw-Hill Book Co., New York, 1969, pp. 167-182.

[2] Tye, Kenneth A. and Novotney, Jerrold M., Schools in Transition: The Practitioner as Change Agent, McGraw-Hill Co., New York, 1975.

[3] Ibid., pp. 106-110.

[4] Ibid., pp. 111-113.

[5] Dillard, Warren; Penrod, James; Gross, Frederick; and Fastman, Gerald, "Agreement between Pepperdine University and Systems and Computer Technology Corporation," pp. 6-7.

[6] ______________, "Pepperdine University Systems Committee, " Unpublished Working Plan between Pepperdine and SCT.

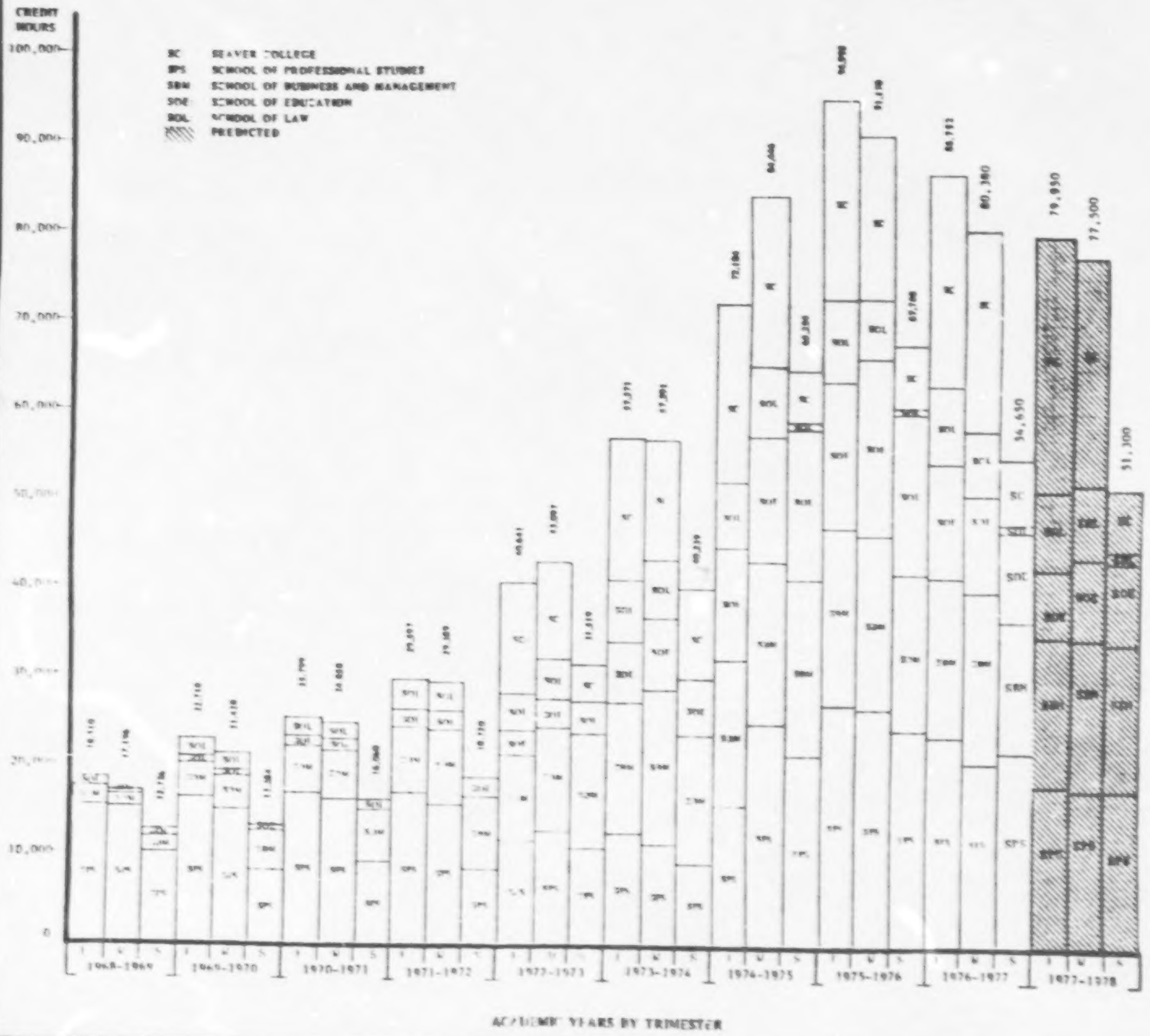
[7] Glans, Thomas B., et al, Management Systems, Holt, Rinehart, and Winston, Inc., New York, 1968, p. 3.

[8] Culbert, Samuel A., The Organization Trap and How to Get Out of It, Basic Books, New York, 1974.

[9] Luchsinger, Vincent P. and Dock, V. Thomas, The Systems Approach: A Primer, Kendall-Hunt Publishing Co., Dubque, Iowa, 1976, pp. 4-6.

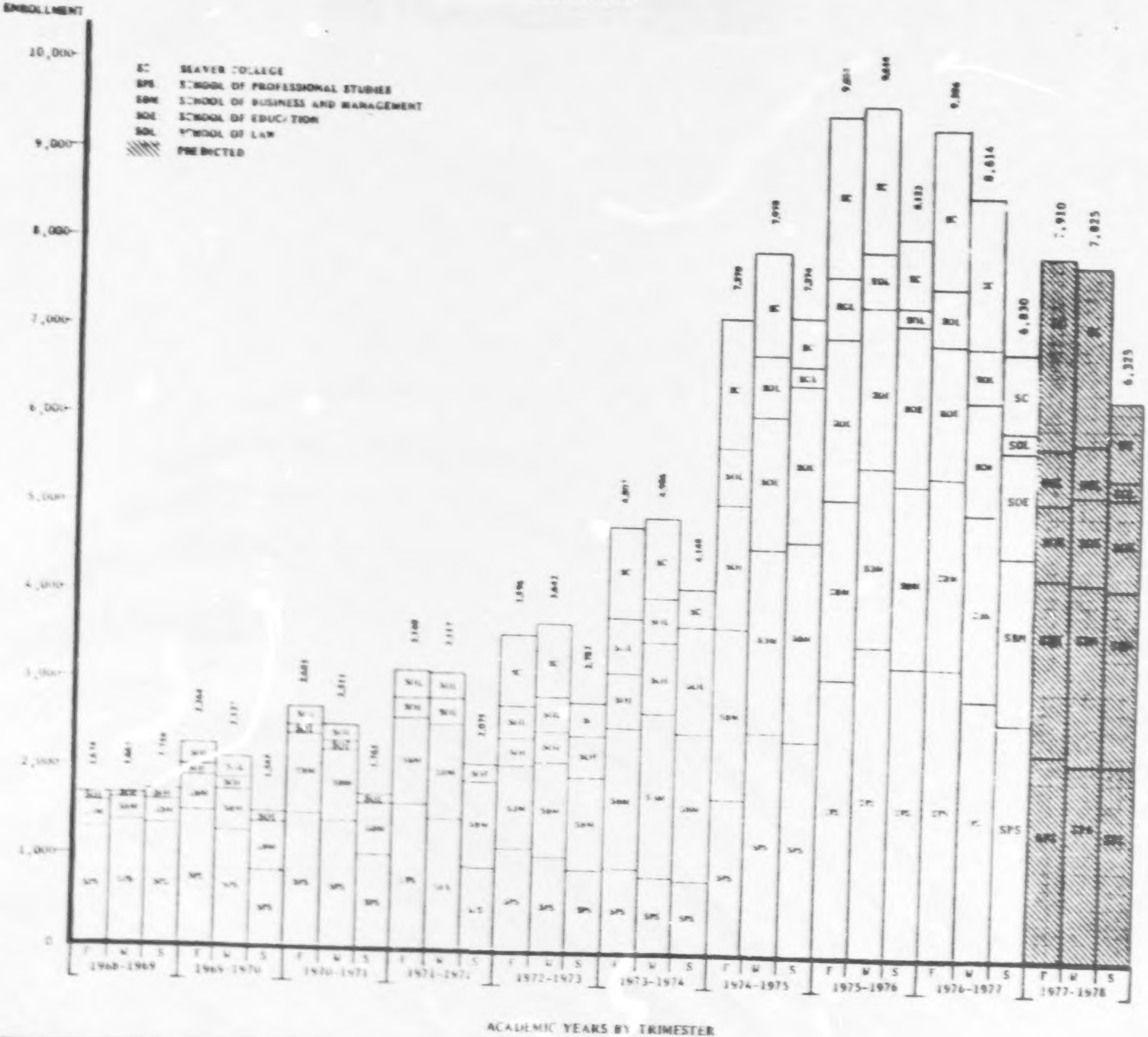
[10] Yasaki, Edward K., "The Many Faces of DBA," Datamation, May 1977, p. 75.

FIGURE 1



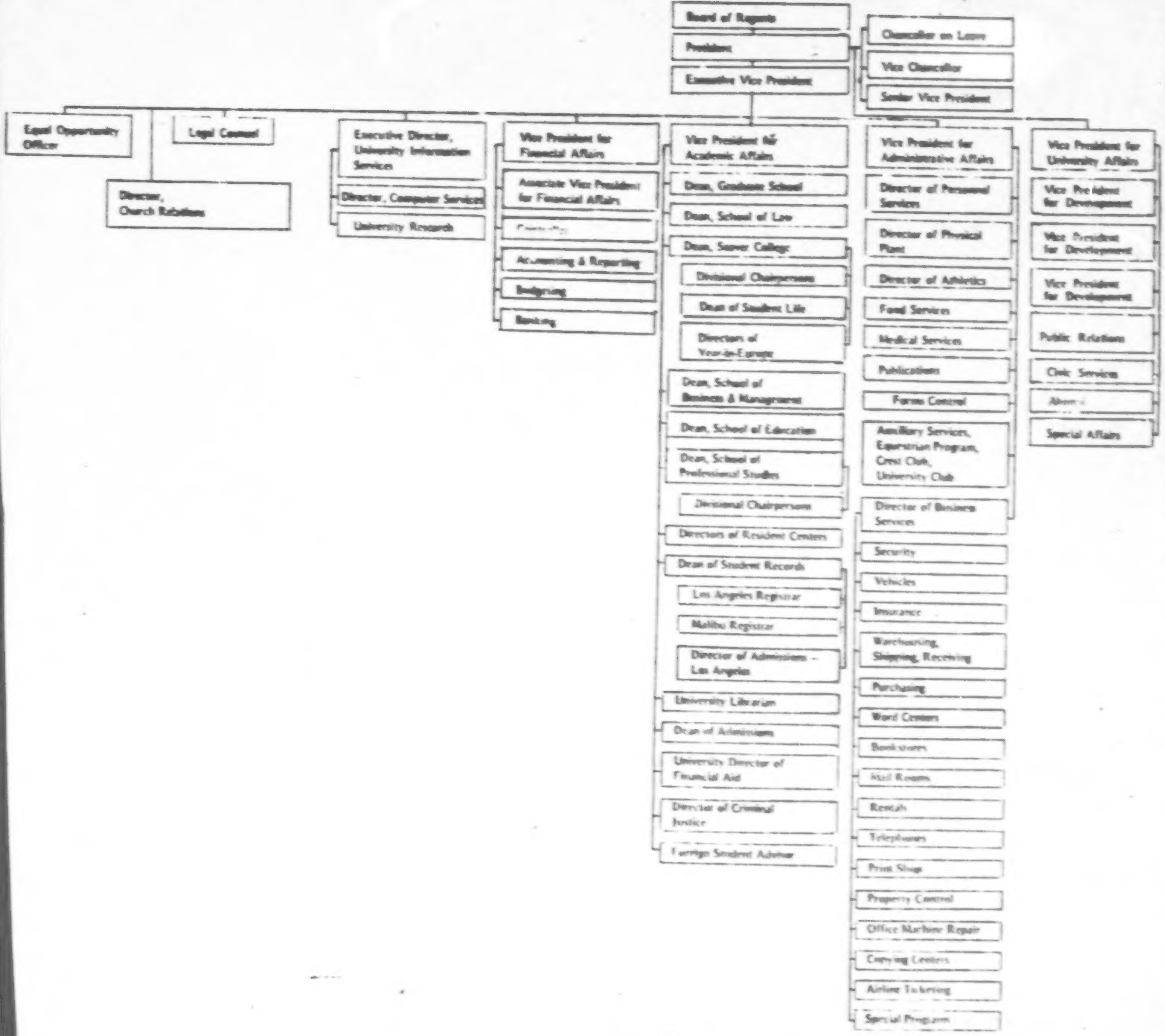
CREDIT HOURS BY SCHOOLS FOR THE ACADEMIC YEARS 1968-1969 THROUGH 1977-1978.

FIGURE 2



HEADCOUNT BY SCHOOLS FOR THE ACADEMIC YEARS 1968-1969 THROUGH 1977-1978.

ATTACHMENT A


Board of Regents
President
Chancellor on Leave
Vice Chancellor
Senior Vice President
Executive Vice President
Equal Opportunity Officer
Legal Counsel
Director, Church Relations
Executive Director, University Information Services
Director, Computer Services
University Research
Vice President for Financial Affairs
Associate Vice President for Financial Affairs
Controller
Accounting & Reporting
Budgeting
Banking
Vice President for Academic Affairs
Dean, Graduate School
Dean, School of Law
Dean, Seaver College
Divisional Chairpersons
Dean of Student Life
Directors of Year-in-Europe
Dean, School of Business & Management
Dean, School of Education
Dean, School of Professional Studies
Divisional Chairpersons
Directors of Resident Centers
Dean of Student Records
Los Angeles Registrar
Malibu Registrar
Director of Admissions – Los Angeles
University Librarian
Dean of Admissions
University Director of Financial Aid
Director of Criminal Justice
Foreign Student Advisor
Vice President for Administrative Affairs
Director of Personnel Services
Director of Physical Plant
Director of Athletics
Food Services
Medical Services
Publications
Forms Control
Auxiliary Services, Equestrian Program, Crest Club, University Club
Director of Business Services
Security
Vehicles
Insurance
Warehousing, Shipping, Receiving
Purchasing
Word Centers
Bookstores
Mail Rooms
Rentals
Telephones
Print Shop
Property Control
Office Machine Repair
Copying Centers
Airline Ticketing
Special Programs
Vice President for University Affairs
Vice President for Development
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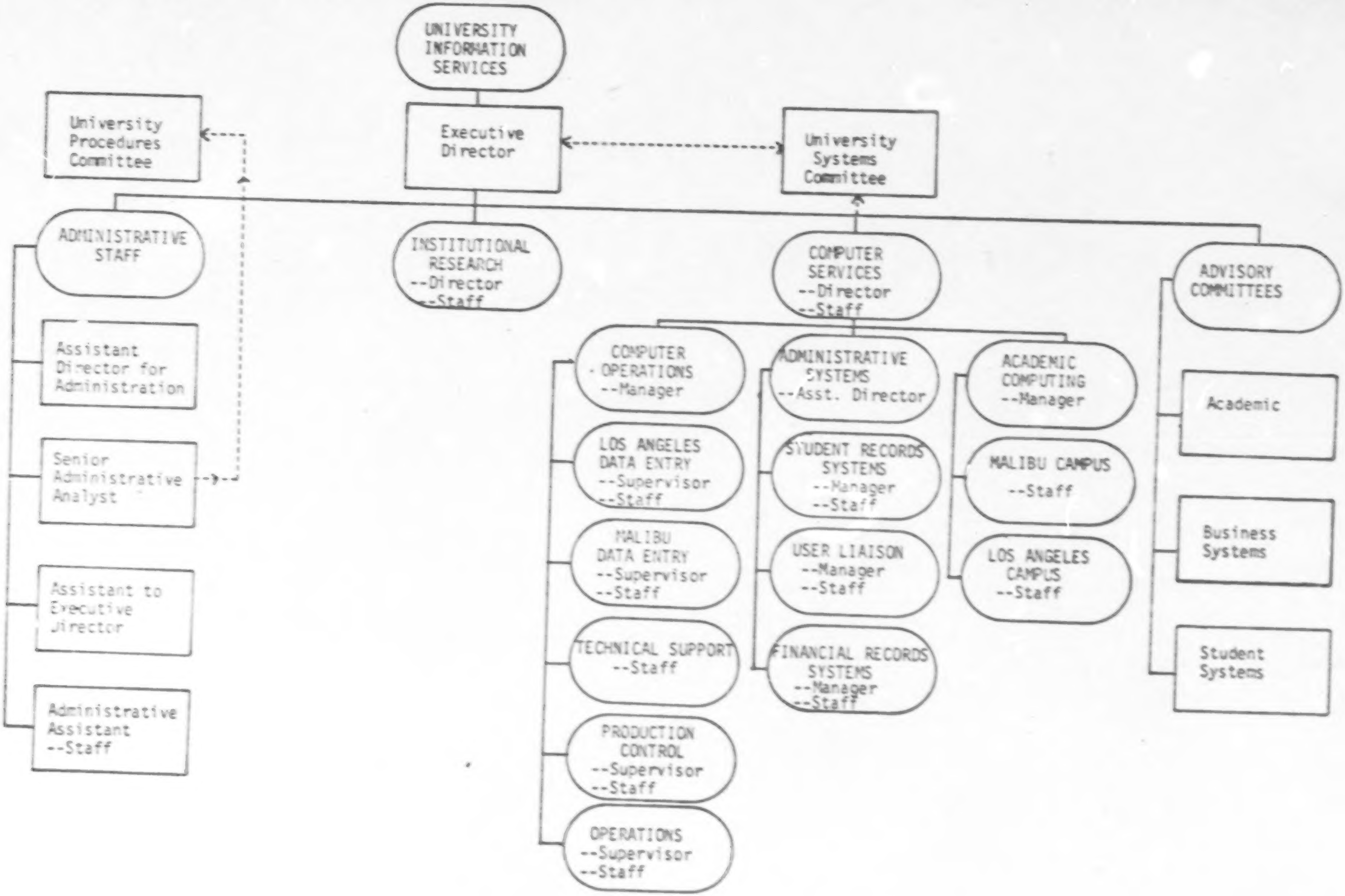
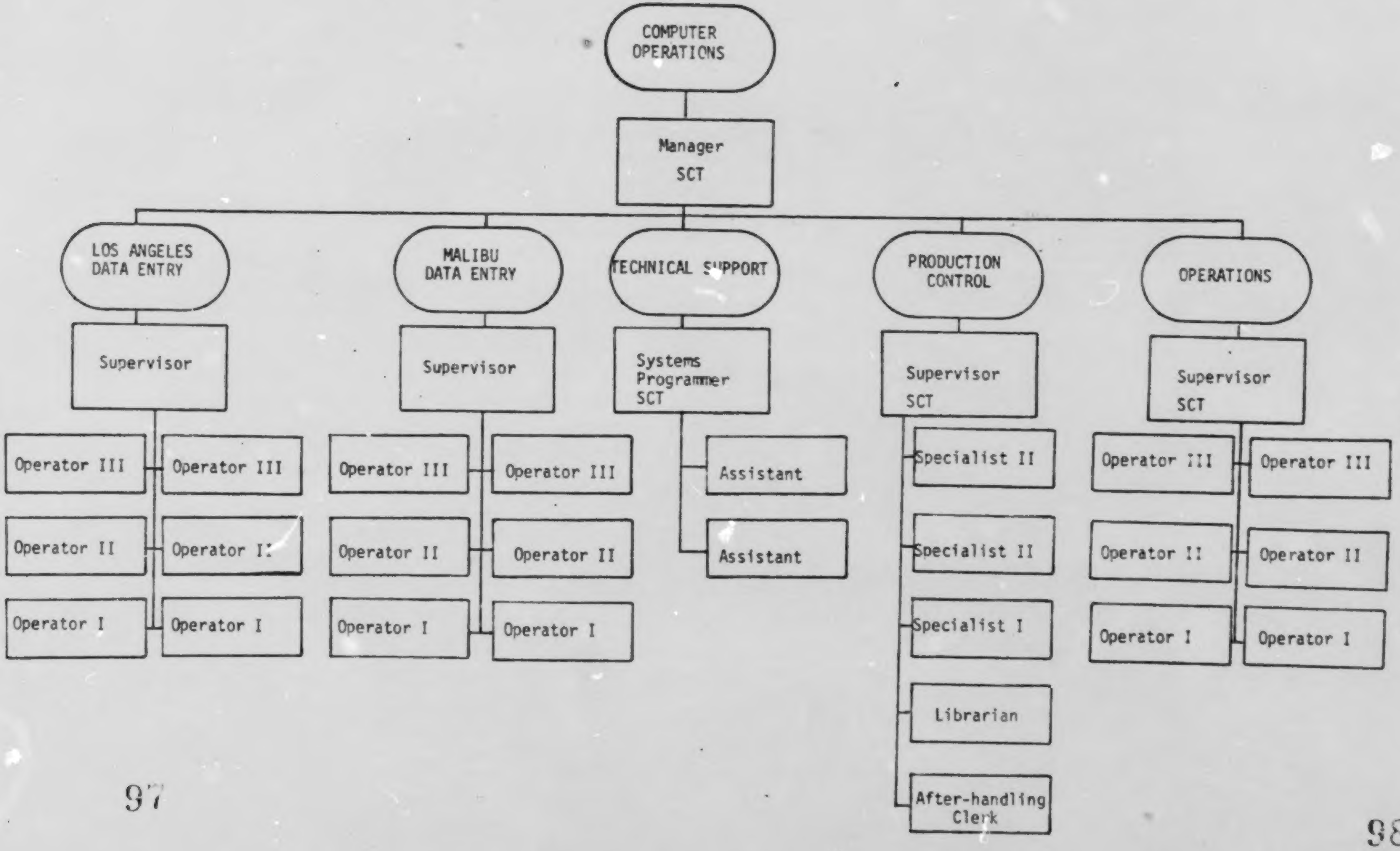
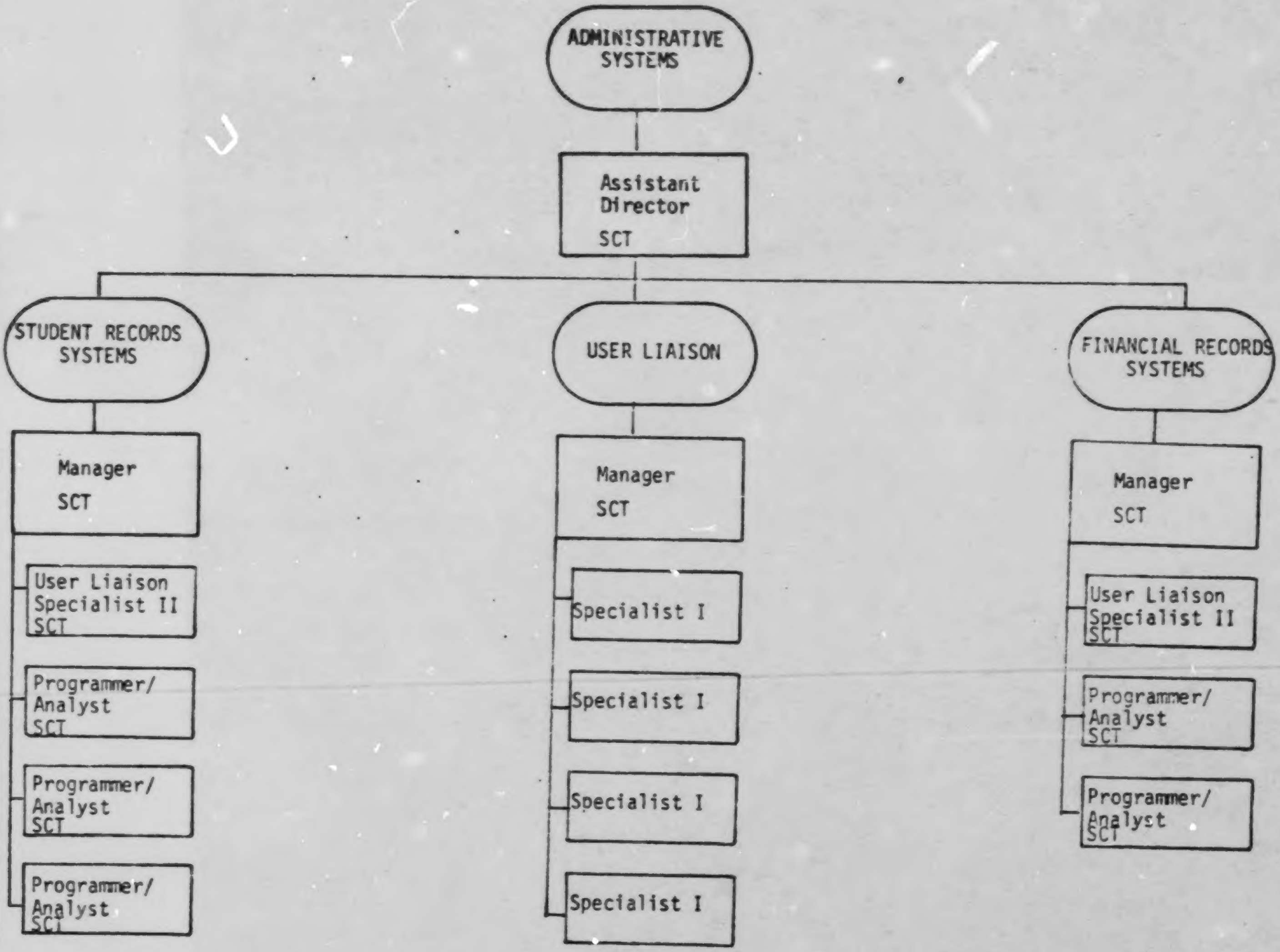
Public Relations
Civic Services
Alumni
Special Affairs


UNIVERSITY INFORMATION SERVICES
University Procedures Committee
Executive Director
University Systems Committee
ADMINISTRATIVE STAFF
Assistant Director for Administration
Senior Administrative Analyst
Assistant to Executive Director
Administrative Assistant --Staff
INSTITUTIONAL RESEARCH --Director --Staff
COMPUTER SERVICES --Director --Staff
COMPUTER OPERATIONS --Manager
LOS ANGELES DATA ENTRY --Supervisor --Staff
MALIBU DATA ENTRY --Supervisor --Staff
TECHNICAL SUPPORT --Staff
PRODUCTION CONTROL --Supervisor --Staff
OPERATIONS --Supervisor --Staff
ADMINISTRATIVE SYSTEMS --Asst. Director
STUDENT RECORDS SYSTEMS --Manager --Staff
USER LIAISON --Manager --Staff
FINANCIAL RECORDS SYSTEMS --Manager --Staff
ACADEMIC COMPUTING --Manager
MALIBU CAMPUS --Staff
LOS ANGELES CAMPUS --Staff
ADVISORY COMMITTEES
Academic
Business Systems
Student Systems

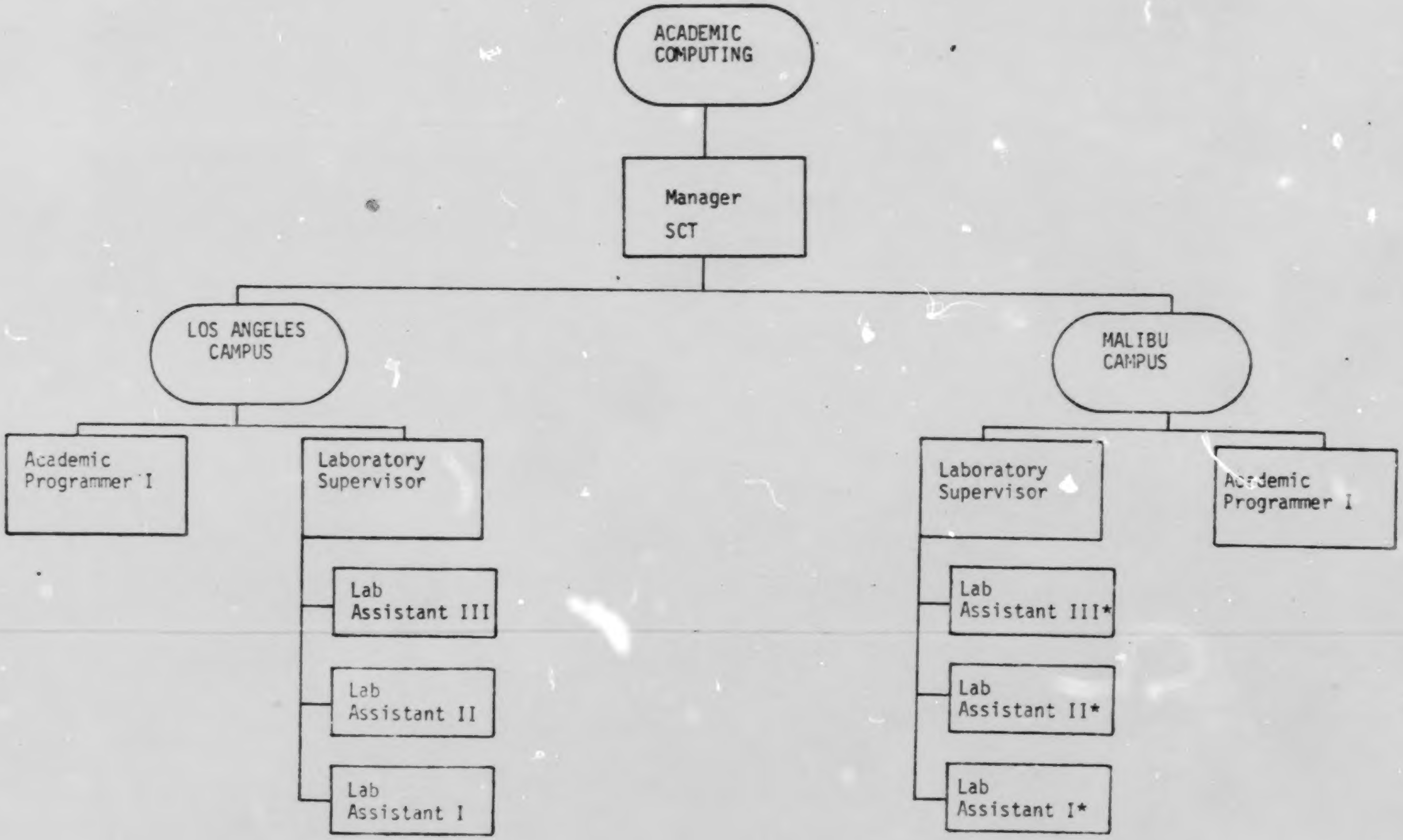
ATTACHMENT B


COMPUTER OPERATIONS
Manager SCT
LOS ANGELES DATA ENTRY
Supervisor
Operator III
Operator III
Operator II
Operator II
Operator I
Operator I
MALIBU DATA ENTRY
Supervisor
Operator III
Operator III
Operator II
Operator II
Operator I
Operator I
TECHNICAL SUPPORT
Systems Programmer SCT
Assistant
Assistant
PRODUCTION CONTROL
Supervisor SCT
Specialist II
Specialist II
Specialist I
Librarian
After-handling Clerk
OPERATIONS
Supervisor SCT
Operator III
Operator III
Operator II
Operator II
Operator I
Operator I

page 2 of 4


ADMINISTRATIVE SYSTEMS
Assistant Director SCT
STUDENT RECORDS SYSTEMS
USER LIAISON
FINANCIAL RECORDS SYSTEMS
Manager SCT
Manager SCT
Manager SCT
User Liaison Specialist II SCT
Programmer/ Analyst SCT
Programmer/ Analyst SCT
Programmer/ Analyst SCT
Specialist I
Specialist I
Specialist I
Specialist I
User Liaison Specialist II SCT
Programmer/ Analyst SCT
Programmer/ Analyst SCT

ATTACHMENT B


ACADEMIC COMPUTING
Manager
SCT
LOS ANGELES CAMPUS
MALIBU CAMPUS
Academic Programmer I
Laboratory Supervisor
Lab Assistant III
Lab Assistant II
Lab Assistant I
Laboratory Supervisor
Academic Programmer I
Lab Assistant III*
Lab Assistant II*
Lab Assistant I*

*These positions are filled with several part-time students

ATTACHMENT C

SYSTEMS SEMINAR
A MODEL FOR INCREASED PARTICIPANT CONSCIOUSNESS IN A PLANNED ORGANIZATIONAL CHANGE

STAGE 1: RECOGNIZING THE PROBLEM

The first stage has to do with turning "feelings of incoherence" into "statements of discrepancies." Two questions which typify this are: "In what ways could this feeling be a clue that the system expects something from me that doesn't seem natural or consistent with my self-interests? In what ways could this feeling be a clue that something which seems natural enough to me is considered inappropriate or inadequate by the system?"

STAGE 2: UNDERSTANDING OURSELVES AND THE SYSTEM

Stage two inputs are the lists of discrepancies derived in stage one. We are to use our inductive thought processes and to approach the lists as symptoms rather than the basic ills and then determine what ailment these symptoms might signal--explaining why we have a difference with the system. "If this discrepancy were a symptom of a more basic conflict, what would that conflict be? What combination of human qualities and organization attributes could have produced conflicts such as the ones we have identified?"

STAGE 3: UNDERSTANDING OUR RELATIONSHIP WITH THE SYSTEM

Stage three inputs are the systems insights and the needs and interests of group members. In this stage, we wish to explicate the assumptions on which our interactions with the system are based and examine how they were formed: (1) goals we held for our interactions with the system and the means we use for achieving them, (2) assumptions about the system: its purpose, values, roles in society, and its way of viewing us, (3) the way we and the system influence one another. Each person's assumptions are recorded and also an attempt to identify the origin of the assumption. The group needs to lend support that challenges existing premises, beliefs, and idiosyncratic assumptions.

STAGE 4: FORMULATING ALTERNATIVES

The fourth stage is designed to formulate alternatives that will improve our relationship to the system. This is done by examining the recorded assumptions which link us to the system versus what we have learned and recorded about our needs, interests, and ideals. Two types of alternatives which may be formulated: (1) those which improve the way the system works and (2) those which change our relationship to it. These are recorded and input into the next stage.

ATTACHMENT C

STAGE 5: AFFECTING THE LIVES OF OTHERS

The last stage begins with the lists of alternatives having to do with personal changes and systems changes. System changes involve affecting the lives of others; thus there is a need to formulate strategies for the implementation of alternatives. It involves approaching people outside of the group who in all likelihood hold very different views. It is best to go to such individuals with a "Statespersonlike" approach, i.e., explore how the system can be improved rather than advocating specific improvements.

ATTACHMENT D

SYSTEMS SEMINAR
End-of-Meeting Evaluation
Date: ____________

1. Were you interested in this meeting?	Very much ____	Quite a bit ____	Some, but not much ____	Very little ____
2. Did you feel that the group was interested in the meeting?	Very much ____	Quite a bit ____	Some, but not much ____	Very little ____
3. Did you learn any new facts or get any new ideas?	Yes, many ____	Quite a few ____	Some, but not very many ____	Very few, if any ____
4. Did you change any of your previous opinions as a result of this meeting?	Yes, many ____	Quite a few ____	Some but, not much ____	Very few, if any ____
5. Were your previous opinions confirmed or strengthened?	Very much ____	Quite a bit ____	Some, but not much ____	Very little ____
6. Did you think the group accomplished anything as a result of this meeting?	It certainly did ____	It probably did ____	I doubt if it did ____	It did not ____
7. Was there enough preparation for the meeting?	More than needed ____	All that was needed ____	Should have been more ____	Should have been much more ____
8. Was there enough opportunity for discussion?	Too much ____	All that was needed ____	Should have been more ____	Should have been much more ____
9. Would the meeting have been better if some parts had been left out?	Certainly ____	Probably ____	Maybe ____	Definitely not ____
10. Did you find the social atmosphere of the meeting congenial and enjoyable?	Excellent ____	Quite good ____	All right ____	Definitely not ____
11. Please give your evaluation (specific comments are appreciated) of the performance of the Facilitator.	Excellent ____	Quite good ____	Fair ____	Poor ____

12. Do you have suggestions (about techniques, materials, etc.) for improving future meetings? (Use other side of page if necessary.)

(you need not sign your name)

ATTACHMENT E

page 1 of 2

ANECDOTAL OBSERVATIONS ON MEETING PRODUCTIVITY

A. Orientation

1. How far did we get?
2. To what extent did we understand what we are trying to do?
3. To what extend did we understand how we are trying to do it?
4. To what extent were we stymied by lack of information?

B. Motivation and Unity

1. Were all of us equally interested in what we are trying to do?
2. Was interest maintained or did it lag?
3. To what extent did the group feel united by a common purpose?
4. To what extent were we able to subordinate individual interests to the common goal?

C. Atmosphere

Was the general atmosphere of the group:

1. Informal or formal?
2. Permissive or inhibited?
3. Cooperative or competitive?
4. Friendly or hostile?

ATTACHMENT E

page 2 of 2

Anecdotal Observations on Meeting Productivity (Cont.)

D. Contributions of Members

1. Was participation general or lopsided?
2. Were contributions on the beam or off at a tangent?
3. Did contributions indicate that those who made them were listening carefully to what others in the group had to say?
4. Were contributions factual and problem-centered or were the contributors unable to rise above their preconceived notions and emotionally-held points of view?

E. Contributions of Special Members of the Group

1. How well did the leader serve the group?
2. The recorder?
3. The resource persons?
4. Those in other special roles?

ATTACHMENT F

RESPONSIBILITY STATEMENT
for
Data Base Administrators

Under the direct guidance of the appropriate vice president (i.e., the Vice President for Academic Affairs regarding Admissions, Financial Aid, Student Academic Data, and Faculty Data; the Vice President for Financial Affairs regarding Financial Records and Budget Data; the Vice President for Administrative Affairs regarding Personnel, Position Control and Purchasing; and the Vice President for University Affairs regarding Alumni and Development Records) a data base administrator is expected to:

1. Participate directly in all related data file development/ construction beginning with records management philosophy and continuing through definition of necessary data elements and files formats;

2. Oversee and manage the construction of necessary input/ output forms and reports including approval(s) of all such documents and any changes requested in their content or format;

3. Assume responsibility for the integrity of and ultimate approval/ denial of non-routine access to the data files for such purposes as special reports, research activities, etc.;

4. Coordinate with deans, directors, and department chairpersons software design, data element definition, training and program testing activities, and data file changes and maintenance. These responsibilities should further insure information integrity and adequacy;

5. As a function of maintaining the Data Base's integrity, it will be the responsibility of the Data Base Administrator to insure that appropriate procedures are documented within the guidelines specified by the University Procedures Committee; and

6. Insure that state-of-the-art data management practices are employed to the extent University physical, fiscal, and human resources permit.

Because data from various University offices and areas is likely to become a part of any data base, the scope of the administrator's responsibility is determined primarily by that of the vice president to whom the administrator reports rather than by the specific office in which he or she is housed.

The Data Base Administrator will, by position definition, be the Chairperson of the Systems Advisory Committee assigned the responsibility for input to the appropriate data area(s). The Chairperson will routinely convene this Committee on a monthly basis, be responsive to the suggestions solicited from the Committee, and advise the Executive Director of University Information Services of Committee recommendations.

ATTACHMENT G

USER MODULE CHECKLIST
TABLES

BEG DT.	END DT.	RESPON. PERSON			

INPUT FORM DESIGN

A. Identify module data elements to be maintained and determine all input forms required for the module.

B. For each input form...

1. Specify data elements to be included on the form
2. Initial design
3. Distribute initial draft for review
4. Make modifications
5. Write procedures for:
   a. completing the form
   b. processing the form
6. Distribute final draft and procedures for approval (this includes computer operations approval)
7. Art work for approved forms
8. Distribute proof for approval and usage estimates
9. Send to printer
10. Printing

TABLE DEFINITION

A. Determine tables required for module

B. For each table...

1. Determine USE/FORMAT
2. Collect/Code Table
3. Review Output/Write maintenance procedure (including forms if required)
4. Make corrections
5. Publicize table/maintenance procedures as required

ATTACHMENT G

USER MODULE CHECKLIST
TABLES

	BEG DT.	END DT.	RESPON. PERSON			
PRODUCTION						
A. Determine functional responsibilities						
B. Establish administrative calendar						
1. Initial module build						
2. Continued maintenance						
C. Establish production schedule including standard parameter options						
D. Establish data entry deadlines						
E. Establish standard distribution						
F. Establish report filing/retention procedures						
CONVERSION						
A. Review conversion specifications						
B. Establish conversion run schedule						
C. Review conversion tests						
D. Develop procedures to handle rejects						
E. Develop procedure for collecting ISIS data elements which are not available on current system						
F. Accept conversion specs/tests						

ATTACHMENT G

USER MODULE CHECKLIST
TABLES

BEG DT.	END DT.	RESPON. PERSON			

TESTING

A. Review documentation

B. Develop testing objectives

  1. TIM edit features
  2. Table lookups
  3. Error messages
  4. System generated data
  5. Output reports
     a. Fields print correctly
     b. Selection
     c. Sequence
     d. Format
     e. Computations

C. Code test transactions

D. Review tests

E. Analyze reports/processes

  1. Processes
     a. Develop general overview
     b. Compare existing vs. new

  2. For each report
     a. Determine USE (especially viewed as a replacement of an existing report or a new tool)
     b. Write procedure for use as appropriate
     c. Write retreival requests as appropriate

ATTACHMENT H

NIVERSITY PROCEDURES COMMITTEE
RESPONSIBILITY MATRIX

roject No: 10.0
roject: Grade Reporting
roject Manager:

EY:

P=Perform R=Review
C=Consult A=Approve

TASK		PLANNED		RESPONSIBLE POSITION	Executive Vice President	Vice President-Academic Affairs	Controller	Dean of Student Records	SBM	SOE	Seaver	SPS	Law	Financial Aid	Admissions	Credits Committees	Legal Counsel	UIS
No.	DESCRIPTION	Start	End															
10.0	Grade Reporting																	
.1	Grade Reporting/Posting	6/16	7/14	Asst. Reg.			R	P	R	R	R	R	R					
.2	Grade Change	"	"	"				P	R	R	R	R	R			C		
.3	"I" Grades	"	"	"				P	R	R	R	R	R					
.4	Late Grades	"	"	"		C		P	R	R	R	R	R					
.5	Grades on other than official form	"	"	"				P										
.6	Changing a letter grade to "CR"	"	"	"		A		P	R	R	R	R	R					
.7	Scholastic Probation	"	"	Chairman, Credits Com		C		R	R	R	R	R	R	C		P		
.8	Removal from Probation	"	"	"		C		R	R	R	R	R	R			P		
.9	Academic Suspension: 1st/2nd Time	"	"	"		C		R	R	R	R	R	R			P		

THE DESIGN AND IMPLEMENTATION OF AN INTEGRATED FINANCIAL CONTROL SYSTEM

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Clemson University has recently designed and is implementing an integrated financial control system. The first portion of the comprehensive system is a complete financial management, budget, encumbrance, and grants and contracts data base and reporting sub-system. The second portion is a personnel/payroll/position budgeting sub-system. The system is designed such that the components serve the needs of specific user areas (accounting, payroll, budgeting, personnel, financial management) and function together in establishing and tracking university fiscal goals. In this paper, the merits of considering integration of systems to meet university-wide objectives as a design criteria rather than as an after-the-fact chore are discussed. Also, the data base organization and several sub-system relationships are presented.

Introduction

Several years ago the administration of Clemson University committed to implement a comprehensive set of business systems to assist in performing routine business functions and in achieving common goals of financial control shared by fiscal administrators. At the outset it was recognized that, to a large extent, the various departments performing business functions not only had unique missions but also shared certain responsibilities and information. Also, it was recognized that systems and procedures to perform business functions must work together in achieving controls deemed necessary. It was within this framework that the administrative data processing staff of the University approached the problems of systems and data base design. This paper outlines the approach taken in system and data base design and traces the migration toward a comprehensive financial system at the University. Rather than a chronology of events, this paper describes the attitudes and design criteria with which an integrated financial system is being implemented.

Environment

Clemson University is a state land grant institution with a three-fold mission of instruction, research, and public service. There are nine colleges as well as an extension service and agricultural experiment station within the University. The University is funded by a lump sum appropriation from the State Legislature on a fiscal year basis, various federal appropriations, student fees, and by other sources. Approximately 80% of its operating expenditure budget of roughly 80 million dollars is for personal services and fringe benefits. As with other governmental agencies and institutions of higher education, there are extensive reporting and audit requirements placed upon the University by the State and Federal governments.

Business Cycle

The analysts involved in the design of the financial systems and data base must begin by viewing in broad terms the fiscal operation of the University. Ultimately, all systems and information must function as parts of this cycle, and a basic understanding of this cycle is mandatory for those people attempting to structure the data and design these systems. The business cycle is viewed as follows:

1. Formulate institutional objectives

   Each fiscal year the University must examine and re-evaluate its activities and formulate plans for the next fiscal year(s) in light of new programs and directions perceived by the administration and governing bodies. These objectives must be formulated and articulated before a financial plan can be developed. This process begins at least a year in advance of the fiscal year beginning.

2. Develop financial plan

   Given institutional objectives, the University must begin the process of securing financial support from the various revenue sources. Objectives, of course, must be evaluated in light of expected financial support. A preliminary fiscal year budget is prepared at a detail level, including a listing of each employee position deemed necessary. This process is completed about nine months before the fiscal year begins.

3. Send budget to State governing bodies

The proposed budget is sent through various governing bodies to the State Legislature for incorporation into the statewide fiscal year budget. Modifications of the budget by the Legislature often force re-evaluation and changes in University goals. The State budget is usually put in a final form shortly before the fiscal year begins.

4. Develop final budget

As soon as the University receives approval from the Legislature and guidelines for staff salary changes, a finalized budget can be constructed and submitted to the Board of Trustees for approval. After this point, the fiscal activities of the new year can begin.

5. Transact financial affairs

Given its mission, financial plan, and budget for the year, the University can begin to implement the plans for the year. Associated with this, of course, are the routine business functions of various departments, including purchasing supplies, printing and distributing checks, collecting money, hiring employees, and other business transactions.

6. Control financial operation

At the time that business affairs are transacted, financial controls must be in place to assure that the financial plan of operation is being followed. This of necessity involves daily controls and procedures as well as periodic financial reports.

7. Report financial information

Periodic reports are, of course, necessary to reflect such things as budgets compared to expenditures, revenue budgets compared to actual revenue, trial balances, and information on the status of grants and contracts. To produce the needed financial reports and to respond to terminal inquiries, the University must have a balanced accounting data base and accurate information concerning such items as budgets, encumbrances, grants, purchases, and employees.

8. Evaluate and begin planning for next fiscal year

As one fiscal year is in progress, the plans for the next year must be underway. Planning information for the current and past years is needed in formulating future plans.

Again, the general nature of this business cycle must be understood by analysts so that all systems and information structure constructed can work within it.

Design Criteria

Given the environment of operation and the business cycle of the University, analysts can now begin the process of systems and data base design. Integrated systems and data can become a reality only if individual department functions and data are viewed as part of a comprehensive picture. The design criteria for the integrated financial systems are as follows:

1. Consider the unique responsibilities of departments within the Business Office.
2. Consider the responsibilities and information shared by these departments.
3. Plan for desired financial controls.
4. Reflect the data structure taking into account items 1, 2, and 3.
5. Design and implement systems that satisfy the needs of individual departments around the common data structure and financial controls defined.

These criteria are explained as follows:

1. Consider the unique responsibilities of each department.

The areas within the Business Office are the following:

Payroll/Insurance

Personnel

Budgets and Systems

Financial Management/Accounts Payable

Bursar/Accounts Receivable

Purchasing

Physical Plant

Auxiliary Enterprises

Each area must have specialized systems to assist in performing its duties, but it is not feasible to design in detail all of these systems before any are implemented. However, migration toward a common data structure and financial controls is possible only by careful study of the needs of each area and viewing these needs as part of a whole.

2. Consider responsibilities and information common to areas.

As departments are studied, it becomes apparent that there are many interfaces. Here are some examples of information and duties shared by departments.

A. Payroll/Insurance-Personnel

Each of these departments has a common denominator of people, each for slightly different reasons. Personnel must insure that people are placed in appropriate positions, payroll must prepare pay checks for these people, and insurance must assist them in selecting insurance. All departments must participate in the processing of information regarding hirings, promotions, changes of employment status, and terminations.

B. Personnel-Budget

Each of these departments is concerned with positions. Personnel places employees in positions that are part of a detail position budget plan established and maintained by the Budget department. Both areas are interested in information on position vacancies for slightly different reasons. Personnel is interested because it performs recruiting functions based upon job criteria and Budgets is interested because a "salary lapse" exists for a period of time.

C. Budgets-Payroll-Financial Management

All of these departments are concerned with accounts from which employees are paid. Budgets plans the amounts appropriate for each account, payroll verifies the validity of and records pay transactions against these accounts, and financial management is charged with establishing these accounts and ultimately reporting all activity against them.

D. Accounts Payable-Personnel

The University operates a state-wide extension service as part of its mission, and as a result pays travel expenses to a large group of employees. Acounts payable prepares all checks to vendors as well as employees who travel or purchase goods for the University, and thus must reference employee data maintained by the Personnel department.

E. Purchasing-Financial Management

Each department must deal with purchase orders and payment information. Purchase orders prepared by Purchasing must encumber valid, budgeted accounts. Financial Management/Accounts Payable must prepare vendor payments and report encumbrance and payment information.

F. Physical Plant-Financial Management-Payroll

Large work orders must be encumbered against valid, budgeted accounts. A work order accounting system within the Physical Plant must route work time information to the Payroll Department, which ultimately submits pay information to Financial Management for proper recording and financial reporting.

3. Plan for desired financial controls.

Careful attention must be directed not only to placing controls in individual systems but also to defining the goals of financial control shared by departments and systems. Two types of financial controls must be put in place: controls to prevent problems and controls to detect problems. Examples are as follows:

Preventive Controls

A. Budget development starting with and producing detailed position information.

Since most of the University's expenditures are for personal services, wage and salary expenditure budgets must be derived from individual position budgets. The budget planning process can use the existing position budget as a beginning and, of course, will ultimately produce position budgets for the next fiscal period.

Once expenditure budgets for salaries are derived, modifications to these budgets must be supported by modifications to individual position budgets.

B. Control Personnel/Payroll actions against position budget

All activity in filling, vacating, and modifying position funding must be coordinated with the detail position budget. The personnel/payroll system must have a direct interface with the position budget maintenance system.

C. Accurately project salary expenditures

If personnel actions are controlled against position budgets and if position budgets are kept accurate, then realistic salary expenditure projections can be made. These, of course, can be useful throughout the fiscal year for budget planning purposes.

D. Encumber expenditures

Planned purchases, work orders, and even salaries can assist in providing an accurate reflection of budget status, and thus be used in preventing budget overruns.

E. Automated balancing

The University accounting practices are aligned with those outlined by NACUBO, the National Association of College and University Business Officers. The financial data base reflects at all times a complete and balanced fiscal status. As accounting entries are entered, the following automated entries must be generated:

1. Postings to revenue control accounts
2. Postings to expenditure control accounts

3. Reduction of vendor bank account for cash disbursements
4. Recognition of increase/decrease in cash equity at state treasurer expenditure clearing account level
5. Detail distribution of cash equity at state treasurer level

F. Budgeting of revenues

Certain amounts of revenues from various sources, such as student tuition, are incorporated in the fiscal plan for each year. These projected revenues must be compared to revenue budgets, just as expenditures must be compared to expenditure budgets.

Detective Controls

These are measures that will alert administrators of existing problems on an after-the-fact basis. Two examples are:

A. Budget variance reports for expenditures and revenues

These routine reports are needed at detail and summary levels to assist in comparing financial activity to planned activity. As a fiscal period draws to a close, the reports are often needed more frequently than at the beginning.

B. Reconciliation with State Personnel Division records

This division maintains parallel records on University employees at a detail level. Detection of inconsistencies between these records and those maintained by the University can lead to correction of University or State records.

4. Reflect data structures.

It is crucial at an early stage to formulate a schematic of major data relationships. These relationships should at first be expressed in the most direct and simple terms, independent of future processing considerations. Natural data relationships must be understood and recorded before detail design of systems takes place. Technical decisions of actual data base design should be deferred for as long as possible, but all system development must relate to a centrally defined, or global, set of data relationships. Experience at Clemson has shown that many technical considerations can in fact be delayed until the start of detail design of a particular system referencing a planned portion of the data base.

The data relationships are defined as indicated in Figure 1.

5. Implement systems around common data structure and in light of common financial controls.

Given data relationships and general goals of financial control, systems can now be implemented that will function both independently and together. An individual system may require data unique to that system, but at some point it will interface with the common data structure and will assist in assuring that common financial controls are provided.

Results to date

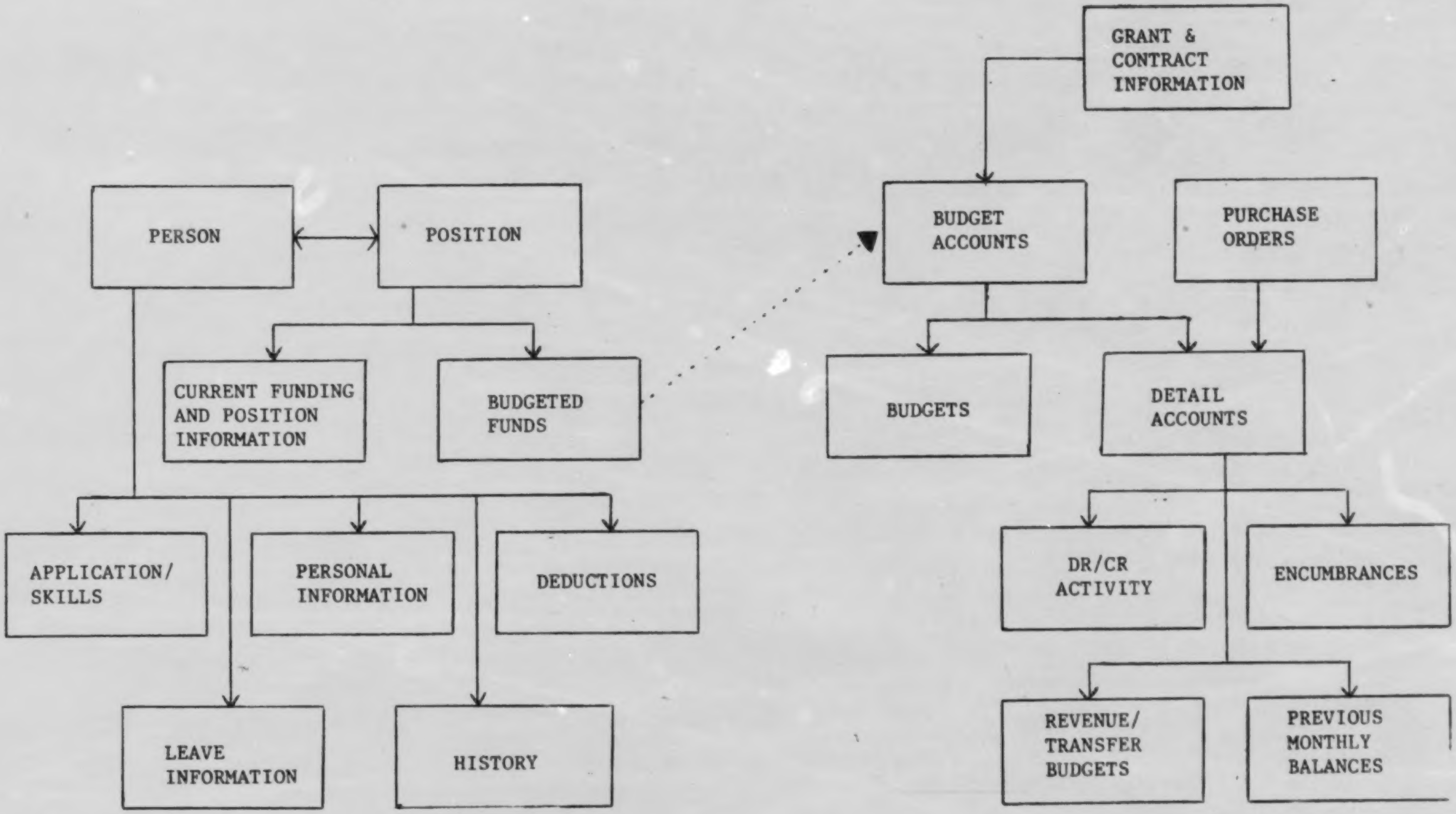
Prior to 1974, several systems had been implemented at the University to serve the needs of the Business Office. These were payroll, personnel, budgets, inventory, and an expenditure/receipt reporting system. A committment was made in 1974 to design and implement systems in a fashion that would result in a comprehensive financial system as discussed thus far. The approach discussed in this paper was followed in structuring the data and planning for financial controls. The first major system implemented was a financial reporting, budget and encumbrance maintenance, and grant and contract accounting system. The next major effort was a budget preparation system for use in both the preliminary and final budget preparation processes. Next an accounts payable and a student accounts receivable system were installed. In process is a personnel/payroll/position budget/insurance system that integrates these functions at the appropriate points. Also in process are a physical plant work accounting system and a program costing system driven by financial information as well as student/course work information. A purchasing system is tentatively planned for next fiscal year.

The front-end investment in definition of data structure and controls appears to have been worth the effort. Analysts now have a comprehensive view of our direction and find that it is difficult to go off in tangent directions on individual projects.

Thus far the efforts of integrated design have been concentrated upon the financial operation of the University. Plans are now being formulated to construct a University-wide data structure that defines and supports all University operations and major goals. Only then can we expect to have systems that support the University in a comprehensive and organized fashion.

Figure 1

FINANCIAL DATA BASE


GRANT &
CONTRACT
INFORMATION
PERSON
POSITION
BUDGET
ACCOUNTS
PURCHASE
ORDERS
CURRENT FUNDING
AND POSITION
INFORMATION
BUDGETED
FUNDS
BUDGETS
DETAIL
ACCOUNTS
APPLICATION/
SKILLS
PERSONAL
INFORMATION
DEDUCTIONS
DR/CR
ACTIVITY
ENCUMBRANCES
LEAVE
INFORMATION
HISTORY
REVENUE/
TRANSFER
BUDGETS
PREVIOUS
MONTHLY
BALANCES

DOCUMENTATION
SPECIFICATIONS AND USER DOCUMENTATION
ALL IN ONE
DOCUMENT FIRST, PROGRAM SECOND

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During the daily operation of a university or business, lack of communication is the most frequently encountered problem. Today this lack of communication often takes the form of insufficient documentation. Unfortunately, documentation is often incomplete, if it exists at all. There rarely is time or motivation to document after project completion. One of the major advantages of this documentation standard is to write documentation first. The documentation is initially used as the project detail specification. It is written in a standard format which can be understood by the least technical person that will eventually use this information as a daily reference manual. This paper explains the methodology of this documentation standard.

During the daily operation of a university or a business, lack of communication is the most frequently encountered problem. The basic function of communication is the transfer of information. The need for information comes in the form of problem solving, decision making, planning, inquiries, designing, negotiating, etc. The lack of organized accessible information directly effects the probability of successful performance in any professional area. In a majority of instances information is stored in someone's head, labeled as expertise. This expertise is all well and good, as long as the individual stays with the company or university, in the same job capacity. When that person leaves, retires, or is promoted, the expertise or information resource is depleted. With information constantly in motion as the experts move around, it is extremely difficult to retrieve or share information. The most reliable solution to unaccessible information is to have as much information written down as possible. Going one step further, a structured framework can be established to format the information, so that as many people as possible have access to the necessary information. A documentation standard is the outcome of the need and commitment to having organized accessible information. The documentation is not a replacement for the expertise of the expert, but rather a means for the expert to share the wealth of information.

Even in the presence of a documentation standard it is common to have very little complete documentation. This is due to the phenomenon of insufficient time to document after project completion, usually because the project is late. Could it be that projects are late, in part, due to poor planning, which in turn is due to a lack of accessible information (documentation)? Even if there is time to document after project completion, motivation is not usually present because documentation is a tedious task at best. Therefore, a documentation standard is not the answer within itself because it doesn't consistently force the documentation to be written or maintained.

Before a project is undertaken, whether it's a completely new system, a new program, or a change to an existing program, some amount of analysis is done. Some form of specification is figured out, whether this is done by the programmers or by a systems analyst is unimportant to this discussion. Specifications traditionally take the form of text. The information contained in the specification should be enough to guide a programmer to write correct programs or make accurate program changes. This information, in possibly a different format, is of importance to everyone who comes in contact with the computer system at a later time, the analyst, programmer, or the users. A major point of this paper is to format specifications into documentation, which will later be used by all employees involved with a system.

Writing the specifications in the form of documentation has three major advantages. First, the documentation is ninety percent complete before the project starts. Second, the documentation will probably be more complete because the in-depth information necessary to create the system or make the change is written down. If the documentation were to be written after the project is complete, details probably would be overlooked. The third advantage of using a documentation standard to write specifications is to give the analyst or programmer a method of organizing what sometimes turns out to be an overwhelming amount of notes, information, and ideas. When a person is provided with a method of organization, the desired results are obtained more quickly and more accurately.

One of the keys to communicating with other people is a standard way to pronounce words, write sentences, and spell. The written communication technique called documentation should be approached from basically the same point of view as a language. Instead of syntax rules let's substitute rules for grouping specific functional types of information into sections, within each section let's require specific information to always be labeled the same way. Publishing these rules for documentation into a documentation standard, used by all people involved with the computer systems, establishes a common denominator for a group of people to interact. What follows is a detailed description of a structured documentation standard, including various comments suggesting its application in a broad range of environments.

A complete set of documentation is necessary for each system (admissions, registrar, library, accounting, payroll, etc.). The documentation for each system should be broken down into the following sections:

I. System Definition
II. System Requirements
III. System Flowchart
IV. Computer System Schedule
V. Control Cards and Files
VI. Inputs/On-line Instructions
VII. Printed Outputs
VIII. Data Files
IX. Jobs
X. Programs

There must be only one place where documentation revisions can be submitted by the various people who are connected with a specific system. A distribution list of people who should receive updates for each section is maintained to assure the most current information in each area. It is not necessary for each person associated with the system to have a complete set of documentation . A sample of those people who should receive each section follows:

COPY	SECTION
Permanent Control Copy	Full Set I-X
Computer Center Management	Full Set I-X
Programming/Analysis Staff	Full Set I-X
Data Preparation	IV, VI, VII
Production Control	I, II, III, IV, V, VI, VII, IX
Operations	I, II, III, IV, V, VII, IX
Users	I, III, IV, V, VI, VII, VIII

The documentation is considered to be a reference manual used not only by the computer center staff, but also by the users. Therefore, documentation which is going to be used by the users must be written in terms that are understood by the least technical person who will use the information. The breakdown of documentation by the suggested sections is by function rather than by program. It must be remembered that most computer systems exist to provide information to users, not to computer programmers. If the documentation is written in terms that a user can understand, it will also be understood by the computer staff. The reverse is not necessarily true.

The "System Definition" should contain a narrative overview of the system. Any existing material which describes the system is appropriate to include here. Include some background about the system, if it is pertinent to understanding the system.

The "System Requirements" contains the system dependencies on resources necessary to maintain and operate the system. The software requirements of the system should be included here (i.e., COBOL, FORTRAN, BASIC, EASYTRIEVE, OPTIMIZERS, VERSIONS, etc.). The hardware requirements of the system should also be included (i.e., optical card readers, sorters, bursters, decollators, number of tape drives, etc.). This would be an appropriate place for the operations manager to include his reorder quantities for special forms supplies.

The "System Flowchart" is a graphic representation of all tasks (machine and manual) in the system, identifying the sequence of tasks and alternatives for recycling through tasks. This is not necessarily at the program level. For example, if there were three or four programs that went into the production of the payroll distribution reports, they would be pictured as one task in this section. Detailed procedures performed by users and computer operations are referenced in terms of predefined processes and procedures.

The "Computer System Schedule" section contains information which will allow production control to both schedule computer time and act as a liaison to the user in providing input in advance of the deadline. The job identification and descriptive name must match that used under the "Job" section. Pertinent facts about each job should be listed, such as frequency of job, deadlines, legal commitments, delivery dates of inputs and outputs.

The "Control Cards and Files" section contains the information necessary for production control to set up the options or controlling functions of a computer job. The simplest form of this section would be control cards, which actually are used to transmit to a computer job options, period ending dates, current or previous cycles, etc. In some installations elaborate software exists for entering of the option and control information directly into a job stream. For each type of control used, there should be a rigid documentation format. This section provides a sample format in which the user supplies the information necessary to have production control set up the controls. The format which would be used for all control cards would contain the following information:

A. Name: A descriptive name of the control's function.

B. File Name: File names associated with the control.

C. Program/Job: Program and job name where the control is used.

D. Messages: Messages and their interpretations which are encountered if the control information is in error during the running of the job.

E. Sample Work Order: A sample work order as it would be submitted by the user. The work order provides production control the information necessary to set up the controls (Fill in the blank document).

F. User Instructions: Instructions necessary for the user to fill out the work order.

G. Sample Control Format: A sample control format to be used by production control.

For other types of controls a specific format must be worked out and universally used.

One of the major points of this documentation standard is that there is a structured format for organizing information which is functionally the same. There exists only one format for documenting control cards, regardless of the system. Documentation is not free format, the emphasis is to create a reference manual, not a novel. There may be multiple formats within a given documentation section, but only when there are distinct differences in functions (i.e., batch vs. on-line).

The "Inputs/On-line Instructions" section contains the information necessary for the user to code or enter data, for data entry to create transactions, and for the programmer to program the edits on the incoming data. This section should be written in such a fashion that it's easily understood by the user, yet complete enough for the programmer to program from. A unique input description is established for each separate transaction, unless different transactions are processed as a required set. It is up to the documentor's discretion whether or not to group transactions.

For the first case of inputs, let's deal with transactions, typically thought of as cards, keeping in mind that this section provides information to the user, data entry personnel, and the programmer. This section contains the following information for transactions:

A. Purpose: Descriptive use of the transaction and type of data collected.

B. Sequence: Any manual sequence in which the transactions must be placed before entering the computer.

C. Frequency: How often the transactions are generated.

D. Volume: What volume of transactions are generated in respect to a time period (per period, week, or month, etc.).

E. Disposition: Where the source documents and resulting cards are kept.

F. Retention Period: The time period documents are kept before recycling or destroying.

G. Programs/Job: The programs and job which actually process the transactions.

H. File Name(s): The file names which are associated with transactions during the running of the job.

I. Transaction Types: Unique ID for each transaction. Transaction codes (e.g., A-add) are also included.

J. Transaction Relationships: Required combinations of transaction types and codes allowed or not allowed in a set of inputs. This includes an explanation of each transaction.

K. Elements: A formatted table with the following column headings:

1. Reference number - a number to cross reference transaction position to source document.
2. Element ID - a standard mnemonic name used in programs to identify the field.
3. Element description - a brief description of the data.
4. Size - maximum number of characters.
5. Positions - beginning and ending positions of each element within the transaction.
6. Definition - exact program checks of each

individual element regarding maximum, minimum, valid range of values, conditions required or not required, relationship to other elements, signed or unsigned, and assumed decimal places.

L. Source Document - a sample of the source document or coding sheet, labeled with reference numbers indicating the elements.

The second case of inputs is on-line entering of data. The major difference between on-line entry of data and transactions is the timing of editing and updating. Editing is typically done at the time the information enters the computer for on-line, as opposed to a batch run for transactions, notifying the user of an error immediately. Basically, the informational needs for transactions or on-line are the same. In the situation where a file is being updated on-line there is no relevance of transaction types and relationships, because the concept of transactions does not exist. During the listing of elements, the positions do not have as much meaning in on-line systems. One part that must be added is in-depth user instructions, including commands and recovery procedures. The last part that must be included for on-line is a complete list of messages that will occur during the on-line system's operation, accompanied with definitions and appropriate responses.

Therefore, the "Inputs/On-line Instructions" section contains information on the preparation of data entered indirectly or directly to the computer. There are two formats in this section, one for transactions and one for on-line systems. These two formats should be applied to all systems.

The "Printed Outputs" section contains the information pertinent to printed reports. This section is used by the user to reference error messages on edit reports and to obtain information about the contents of a report, or by a programmer to make changes to a report. The format used for each printed report contains the following parts:

A. Purpose: Use or function of the report.

B. Form: Paper size, copies, and special forms description.

C. Sequence: Sequence of the report or control breaks.

D. Frequency: How often the report is generated.

E. Volume: Number of pages or forms, including periodic or seasonal fluctuations in volume.

F. Disposition: Distribution of the report, including any bursting or decollation.

G. Retention Period: Length of time the report is retained by the recipient of the report.

H. Program/Job: The program and job that generates the report.

I. Contents: A formatted table with the following column headings:

    1. Reference number - a number to cross reference

the definition to the printer spacing chart or sample.

2. Element name - a descriptive name of the item being defined.
3. Definition - definition of the item. It is important to define even the most obvious item, because it may not be obvious to the user. Page breaks should be defined when documenting page numbers or totals. Calculations which are done to generate an item should be included.

J. Messages: The message exactly as it appears on the report along with the meaning of the message and corresponding actions to be taken.

K. Printer Spacing Chart: Represents not only detail lines but also total and heading lines.

L. Sample: When a comprehensive sample can be obtained, it should be included, but only when it does not include confidential information.

The "Data Files" section contains detailed information concerning the contents and format of stored information. This section is mostly the concern of the programmer. This section contains two separate formats, one for sequential, ISAM, or random files and one for data base schemas. The information for sequential, ISAM, or random files has the following format:

A. Data Set Name: The actual system name(s) used for data file labels. If this file is used in several places and has several names, list all of the names.

B. File ID: Symbolic name used by the program. The need for this varies depending upon the language and operating system being used.

C. Purpose: Use of the file (e.g., master, temporary, work files, etc.)

D. Media: Tape, disk, or cards.

E. Organization: Sequential, ISAM, or random.

F. Recording Format: Fixed, variable, or undefined.

G. Sequence: Elements and positions of keys in which the file is maintained.

H. Record Length: Number of characters per record.

I. Blocking Factor: Number of records per block. Where applicable, show calculations used to determine blocking factors.

J. Storage Requirements: Disk space or number of tapes.

K. Retention Period: Time period before recycling file, this is particularly important when using tapes.

L. Programs/Job: All programs/Jobs which read and/or write this file.

M. Elements: A formatted table with the following column headings:

1. Reference Number - sequence number of field.
2. Element ID - a standard mnemonic name used in programs to identify the field.

3. Element Description - a brief description of the data.
4. Size - maximum number of characters.
5. Positions - Beginning and ending position of each field within the file.
6. Definition - All valid values for each field and their corresponding codes, packed, numeric, binary, signed, and relationships to other fields. The keys should be noted when documenting ISAM or random files.

The second format for the "Data Files" is used to document a data base system and is dependent upon the data base system being used. A schematic of the data base should be included in this section along with detailed information about each sub-file. The security system should be explained along with any other chaining and accessing information. Whatever data base system is being used, a structured format for documenting the data base system should be developed and used for all applications.

Therefore, the "Data Files" section contains detailed information about the storage of the data. There exists a duplication of information between data files and inputs in the form of field definition. This duplication facilitates the usage of documentation used as a reference manual. There are two formats in this section, one for sequential, ISAM, or random files and one for data base systems.

The "Jobs" section contains information concerning the operational procedures of running a job. This section is of primary concern to production control and the computer operations staff. The definition of a job in this context is a program or group of programs which is set up by production control and run independently of the programmers. This section has the following information:

A. Job ID: Mnemonic given to the job name.

B. Purpose: A general description of the job.

C. Schedule: Frequency and time of runs. Note here any jobs that must precede or follow. Also include any obligations to process this job (i.e., W-2's must be produced before January 31). This information should be in the "Computer System Schedule".

D. Set up Procedures: Any procedures for tapes, special forms, etc.

E. Submit Deck: List of all cards to be included in submit deck for the job.

F. Stream: Current listing of JCL.

G. Job Flowchart: Standard flowchart indicating exact names of all inputs, data files, job steps, programs, and outputs in processing sequence. Optional and restart paths are to be indicated.

H. Restart Instructions: All considerations which must be observed to restart or rerun the job.

I. Messages: All program generated abort and exception messages and their meanings.

J. Printing Instructions: Appropriate instructions for processing special forms, such as alignment, breaks in the forms, and number of copies. Include a sample carriage control tape, if non-standard.

K. Job Release Criteria: Requirements of production control may be to balance basic totals to insure complete processing of files. Any other checking production control can do to verify complete processing.

L. Output Disposition: Disposition of printed materials, tapes to be processed by outside firms, and forms requiring additional handling. Include instructions concerning decollation and bursting.

M. Input Disposition: Disposition of any input materials and source documents.

The "Programs" section contains specific information pertinent to the program's inner workings. This section contains information only important to the programmer, all other information should have been included in the other sections of the documentation. This section contains the following format:

A. Program Name: Mnemonic used to identify the program.

B. Purpose: Description of the program's function.

C. Language: Language used to write the program.

D. External Programs: Subroutines or macros.

E. Input Files: Names of all files input to the program, including both the symbolic name and the system label where applicable.

F. Output Files: Names of all files output from the program, including both the symbolic name and the system label where applicable.

G. Input/Output Files: Names of all files input and output (i.e., work files) from the program, including both the symbolic name and the system label where applicable.

H. Jobs: All jobs in which the program is used.

I. Coding Notes: Techniques or calculations that require explanation. Explanation of processing of stored fields which are not directly altered by user input.

Documentation should never be considered static, but rather dynamic, being updated as requirements change and procedures are refined. The objective of having documentation is to assist staff in performing their required duties. This enables the computer center to be responsive, delivering committed products on schedule to the various offices and departments. The documentation standard provides a structured framework and guideline for the development of documentation.

Data processing documentation must satisfy two important objectives. A data processing system must be self-sustaining. Under normal conditions documentation must allow both operations and user personnel to operate the system and obtain all outputs without inquiry or consultation with the programming staff. This means that documentation must not only be comprehensive and usable enough to allow user and operations staff to handle all normal processing, but also to allow them to recycle, reschedule, and recover from minor failures without programmer assistance. A data processing system must also be maintainable. Documentation provides the reference to allow systems and programming personnel to modify, revise, and expand the system and all programs in that system, while determining the impact of such modifications on the current system. It may be necessary to change inputs, outputs, data files, or work flow. To do this, all pertinent information regarding that system must be available to the programming staff in order to provide a corrective potential.

Documentation is a major communications link between the computer center and the user. The user can relate to the controls, inputs, and outputs which represent the computer system to the user. Production control has a link to the user via the controls, inputs, and outputs. On the other side, production control has a link to the operations staff through controls and jobs. Data preparation has a link to the user through inputs. The programming staff also has a communication link to users, production control, data preparation, and operations through documentation.

The design of a computer system follows a logic path which is divided into functional areas identical to this documentation standard. The first step in designing a system is to determine what is the required output of the system. Once the outputs are defined, a determination of how the data will be input to the system is defined. The third step is to determine the manner of storing the information (data files). The fourth step overlaps the third step, that of determining the processing steps and methods of transforming inputs to outputs. The fifth step is to establish controls to insure security and smooth operation of a system. Since the documentation standard is aligned so closely with the design of a computer system, it lends itself to being used as the format for writing detailed specifications. These specifications are usable not only for the programmer, but later for the user, which leaves no excuse for incomplete documentation at project completion.

A most important issue of this paper is that changes are specified using the documentation, thus insuring current documentation and organized detailed specifications. For changes made to existing systems, copies of the existing documentation are marked for retyping to represent the required changes. This insures that documentation is always up to date.

When this documentation standard is followed religiously, the documentation becomes a valuable source of organized accessible system information. Because the documentation is divided into functional sections which are identical to the major steps involved in developing a new system, it lends itself to being used as a standard format to write specifications. Since specifications are written as documentation, it insures current documentation at all times. With the awareness that users need access to certain portions of system documentation, these sections are written with the user audience in mind. The end result of using this documentation standard is more reliable, current information to respond to problems in a timely manner and to plan for the future.

ADVENTURES IN DISTRIBUTIVE DATA PROCESSING

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Working from the sketchiest of objectives, i.e., redundancy for reliability and off-loading the central host, this paper outlines the steps taken by an institution in converting a centralized on-line registration and enrollment system for 65,000 students to a truly distributed processing approach to the same problem.

Considerations made for hardware, software, distribution of data, data integrity, communication protocols, economics, and alternative strategies relating to which functions to distrubute and which to remain the purview of the central host will be discussed.

ADVENTURES IN DISTRIBUTIVE DATA PROCESSING

Either nobody knows what it is or everybody knows what it is. Either it can be defined and you can get your arms around it or it's what everybody is doing and they use that label for it. How can you decide what it is? It probably is necessary to use the context of your requirement. Most every vendor offers DDP and has the solution to your problem and will be more than happy to supply that for you. The problem that we find is that the more you look into it the more simple the offering is and the more complex the system that you, the user, are going to have to implement in order to make any use of it. As you go through the literature and as you listen to the vendors, you find all kinds of definitions - some people will use definitions that describe interactive on-line language. From a logical point of view, ignoring telecommunication line costs, it seems on-line interactive systems can be just as distributive as actually distributing physical devices. Another definition that lots of vendors use can be netted down to remote batch processing. You may do all kinds of logical things on the distributed processor, the mini-computer, the micro-processor or whatever it is, but periodically and maybe even off shift you send a batch to the central site. You'll find that the going definition of distributive processing as far as most vendor offerings are concerned.

We've attempted definitions of DDP that we thought met the kinds of requirements that we have and, frankly, have not been able to simplify it. We think it is a network of independent processors remote from each other, i.e., all but one outside of a computer room, processing equal or unique functions with distributive data either redundant or unique, which has relatively real time access and/or reconciliation. We might call that Interactive Distributive Data Processing or IDDP. That definition kind of points up the problem in that it goes from the simple to the very complex in very short order. The "Coast Project," which we are going into this year, will implement something that meets that definition.

Our plans are to select some hardware by the end of this calendar year and start into software development, not applications development at all, so that we can have a system that meets our definition before we write our first application on the system.

Why are we doing this? As some of you know, we have been working on ways of increasing reliability by providing backup systems for some time. The approach we have taken currently is very expensive. Right now we have redundant central processing.

We are looking and experimenting with other alternatives to insure the same level of reliability and backup with some less cost. At least for the moment, Grsch's law has not been reversed, contrary to some things that you may have heard from the mini and micro people. When you go to two processors you simply are not getting the same bang for the buck that you would get with a larger one. You read almost every day that these economies of scale things are no longer applicable. We haven't found that to be the case yet.

What are our goals and objectives for this project? They're two fold. Basically they are reliability, which means in our case redundancy with the ability to do something if part of our system fails, and economic. I frankly think that there are no other justifications. The literature is full of motherhood statements like 'decentralizing the computer power to the users.' This gets into the questions that we discussed earlier, i.e. physical versus logical capability and centralization or decentralization of those kinds of things. If we only are interested in decentralizing the processing capability then there really isn't any reason why we can't do that with some interactive on-line language without spreading processors all over the place, thereby saving us all the difficulty of distributive data which in essence turns out to be the biggest problem in distributive processing. "Bypassing the data center bureaucracy" is another objective sometimes heard. The economic objective is much more real. To go from one central processor to another central processor can be a large increment of money. For instance, the difference between a 158, if you happen to run out of power on a 158, and a 168 is a substantial amount of money. So you have some choices at that point as to what you are going to do about it. Frankly that hole between the 158 and the 168 is a gigantic hole - it's at least four times the power and at least two or two and a half to three times the cost. Incremental growth when you reach holes like that is a serious problem and distributive data processing is one of the ways that you can address that problem. You can get some additional power through off-loading some of the things you've been doing centrally so that you can have incremental growth. That is certainly one of our objectives. If this kind of an approach works out, we probably will go back to a uni-processor concept getting our reliability and economics through the distributive approach.

What are the external requirements for implementing a distributive network? We have been investigating this for many months now. We have found an extremely wide array of offerings yet an extremely limited offering in some respects. Before going out for bid for our hardware we looked at almost every manufacturer of hardware of the size we were interested in. We decided earlier that we wanted this to be a small project; i.e., driving about 6 terminals and a printer with communication with the host. You can find lots of systems, particularly the large minis, which have all kinds of facilities available to them such as operating systems and high level languages. The problem is that they were not really intended for distributive processing. They were designed to be standalone, i.e., the software is designed to be standalone. While vendors claim that they are in the distributive processing business, they actually want to sell you the system as is. The most critical part of the problem is software. There is a wide array of software available for large systems. However, such is not the case when you get down to the size of processor that we were considering. For instance, there aren't very many processors that have a truly interactive COBOL on it. There are very few that have what we consider to be an acceptable disk access method, i.e., a good index sequential, and even fewer, of course, that have any kind of data base management system associated with them. There are beginning to be some but they're not very far along in that area.

We have essentially found that they are still trying to sell their standalone systems no matter how small or large. They have even less flexibility than the larger mainframe manufacturers, i.e., they are unable in many cases to allow you to use your own terminals. They insist on one that they provide and have no software with the flexibility to support others. In most cases it is much easier to put together hybrid hardware systems, i.e., disk drives and memory, than it is to support things like foreign terminals. We have found that almost every vendor is trying to sell you a comprehensive system rather than components with flexibility in their software that will allow you to do what you would like to do. In our case we already owned the terminals and really wanted to use them. Finding an operating system and/or high level language to support them was the problem. That kind of flexibility just wasn't there. Not many systems have established host to host protocols. A few of them do. A few of them have some device dependent modules that will allow your distributive processor to look like some standard to your host. The most common of these is a bisynchronous port and a little bit of software to make it look like a 3270 or some other of those bisynchronous IBM devices. Of course, it isn't necessary that you use things like that; there is a little more reliability in synchronous kinds of communications than there is in others; but it is possible to make the intermediate processor look like a dumb teletype, for instance, and computers can communicate with each other in asynchronous start/stop ascii mode and probably get by with it. As long as your communication load and your error rate doesn't get too high, that mode will work although you still have to write control software. The complete protocol really isn't available from the vendor as part of his software. Almost all of the offerings are so terribly limited that you as a user are going to have to get involved in projects of software development that you may not be currently interested in doing. There is not a panacea sitting out there just waiting for you to just lay distributive processing on your shop.

A set of internal requirements are the questions that people have to ask themselves before they can successfully take on a venture of this nature.

Where shall which work be accomplished? That simply means that you must decide whether to process in the host, in the intermediate processor, or even in an intelligent terminal. We solved that problem pretty handily. We were not going to put anything in the distributive processor that is not also in the host. The problem is the data - where which data is stored, whether or not it is to be redundant or whether it is to be unique - those are questions we decided. Our data is going to be redundant, it is going to be a subset of our full data base; a subset associated with geography and function. One of our goals in this experiment is to come up with a system that we can move to different applications, without redoing the software system. We should be able to use this distributive system with business applications, registration applications, schedule building applications, or any other, by simply writing application code and by not having to write software over again. To that extent we have tried to generalize our concept so that once we implement it will be applicable in different areas.

What is required in case of failure? If you think you've got problems with on-line systems and data base management systems in point-of-failure recovery and restart, it is much more complex in this kind of a network. It's one of the most complex subject matters that you can get into in a simple on-line system but when you get into a distributive system it is more so. You must develop a strategy and a procedure so that you don't lose data. That is a subject that people with on-line systems deal with consistently and only sometimes successfully.

How important is data reconciliation? Do you care whether or not data in your host and data in your distributive processor are the same? That is an issue you have to decide. Is there a hierarchy of data that has different reconciliation requirements. Does your data fall into either later batch, relative real time, or real time reconciliation categories. Those are considerations that have to be made. Real time requirements for data reconciliation requires that the distributive system be interactive.

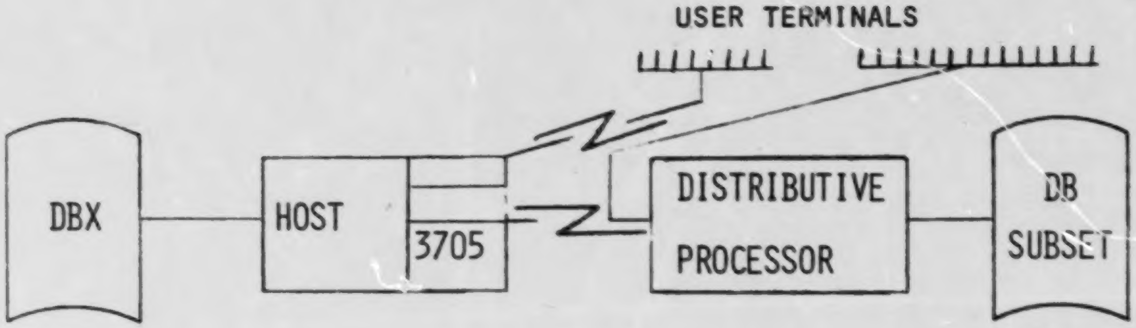
"The Coast Plan" is essentially an effort to develop generalized software which allows flexible timing in function development. We plan to be able to put this system into use before we write the first application function on the distributive processor. One of the things that we want to be able to do through the distributive processing system is to store and forward any function requests that don't exist on the distributive processor. Theoretically we could have no user functions on the distributive processor; just store and forward and get back results from the host.

We used software as a criteria for hardware selection. If we have learned anything, it is that the hardware is essentially available, but you can't do much with it. What you can do is highly dependent upon the kinds of supportive software that is available. Therefore, we're going to use software criteria for the selection of the hardware. Ease of development and also protection of investment are two criteria which are addressed by software. We want a high level language, which is different for us because we currently are an assembly shop, to protect our investment by reducing future conversion costs. Ease of development is probably the biggest criteria. We would like the software we develop to be upward compatible. If we move the concept into the business system, or the personnel system, or a combination of business and personnel, it may require a different size processor. We will certainly try to standardize on software and hardware so that if we go for a bigger or faster system we will still have the software investment protected.

We plan to develop functions for distributive processors that already exist on host. That simply means that we are not going to do any more user design, except coding design. After we get the generalized software, it essentially becomes an off-load project. We want to take some of the functions that are currently on-line to the host and put them on the distributive processor In order to accomplish this, we are going to use a hierarchical approach; a very simple one with a single processor and six terminals and a printer, with a port to the host. We are going to start in the administrative area rather than the instructional area probably because administrative distribution is more difficult. As you know, instructional systems kind of tend to do their own thing. We could probably put a distributive processor out there that runs its own Basic and comes to the host for APL without too much of an effort. We think if this thrust into administration is successful, our experience will make it easier for eventually putting it into instruction as well.

Figure I shows a schema of what the environment would look like. Our thoughts at the moment are that the first implementation will go into the registration/enrollment system. It also will be a non-exclusive kind of a system, i.e., we will

FEATURES OF GENERALIZED SOFTWARE



GENERALIZED SOFTWARE

HOST FUNCTIONS

1. TABLE OF ELEMENTS IN DB SUBSET
2. STORE AND FORWARD PROCESSOR (VARIABLE PRIORITY DEMAND QUEUEING SYSTEM)
    - A. SEND APPROPRIATE DATA ELEMENTS TRANSACTION TO DISTRIBUTIVE PROCESSOR SYSTEM (RETURN CODES, ETC.)
3. POINT OF FAILURE AND RESTART PROCESSOR

DISTRIBUTED FUNCTIONS

1. TABLE OF RESIDENT FUNCTIONS
2. STORE AND FORWARD PROCESSOR (VARIABLE PRIORITY DEMAND QUEUEING SYSTEM)
    - A. SEND ALL DATA TRANSACTIONS TO HOST DATA BASE (RETURN CODES)
    - B. FORWARD FUNCTION REQUEST TO HOST WHEN NOT AVAILABLE
    - C. DATA REQUEST TO HOST WHEN NOT AVAILABLE - PROVIDES DATA OR UPDATE
3. POINT OF FAILURE AND RESTART PROCESSOR

Figure I

still have terminals in that area which are connected directly to the host and IDDP will probably be limited to the enrollment function. The distributive processor and the host both will be going against the same data - data which exists in two places. That, in essence, is the technical problem.

What are the functions of the IDDP software system? On the distributive side we must probably always go into a table of resident functions and on that basis decide whether we are going to execute there or store and forward the request on to the host. We must develop a subsystem which we call a store and forward processor. This store and forward system must be a variable priority demand queueing system. That simply means that you decide which data has which timeliness requirement and you queue and store and forward based on those criteria. As you know that's not simple. We have to send all the data transactions to the host which are executed in the distributive processor and for which data exists in the distributive processor - we forward function requests to the host when they are not available in the distributive processor and we go after data in the host when it is not available in the distributive processor. There are two situations with the latter, one when the data space has been allocated in the distributive processor but when the desired data has not yet been forwarded to the distributive processor, the other when you didn't intend it to be there and intended to always go to the host to get the data. In one case you go immediately to the host to bring the data back to the function and in the other you go to the host to bring the data back to the file and then execute the function, a truly complex process. As mentioned earlier, a point of failure and restart processor is required.

On the host side of things, you're going to have to have some sort of a table of elements that shows the contents of the data base subset because when updates come directly to the host, the host is going to have to send the transaction to the distributive processor. That is a classical use for a data dictionary. No general data dictionary system exists that includes this kind of activity because no distributive data base system exists today. Secondly, we must have the same kind of store and forward processor in the host, it will have to be written for the transaction teleprocessing system in order to do the same kinds of activity, only in reverse, that we were doing out in the mini. You've got to be concerned, as we all are now, with point of failure and restart, i.e., what do you do with these queues when nothing is available out there to send them to or when you actually take the data off the queue. There is just a whole array of complexities involved with this particular subject.

That is about as far as we have gone so far. The further we investigate this particular subject the more we realize that it has been greatly oversold in the literature and certainly over-simplified by the vendors. The requirements on the part of a user are heavier than you would be led to believe. It should be emphasized that our project is just an experiment. Frankly we have made no commitment to any user for installation. We don't intend to do that until we've got something that we feel is of value to both of us. Hopefully by the end of the fiscal year, the June, July, August time frame of next year, we will have our first experiment on the air and we will be able to report to you as to the project success or failure.

ADVENTURES IN DISTRIBUTIVE DATA PROCESSING SYSTEM FUNCTIONS

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(See page 155 for abstract.)

INTRODUCTION

This paper will attempt to summarize the various system functions and software solutions we at Coast have proposed to provide a truly interactive distributive environment.

The primary objective of the Distributive Processor Project at Coast Community College District is to provide the software needed to support incremental development of application systems presently available on the central host.

This support includes the ability to access all functions available on the host and distributive processor without user knowledge of their location. Data management support includes redundant data base synchronization and host retrieval of non-redundant data.

The purpose of this support is to provide device independent applications development on the distributive machine. This paper will attempt to define the requirements necessary to accomplish this task as it relates to the Coast environment.

SYSTEM OVERVIEW

In order to provide for incremental application development, functions which are currently resident solely in the central host must be made available to the distributive processor.

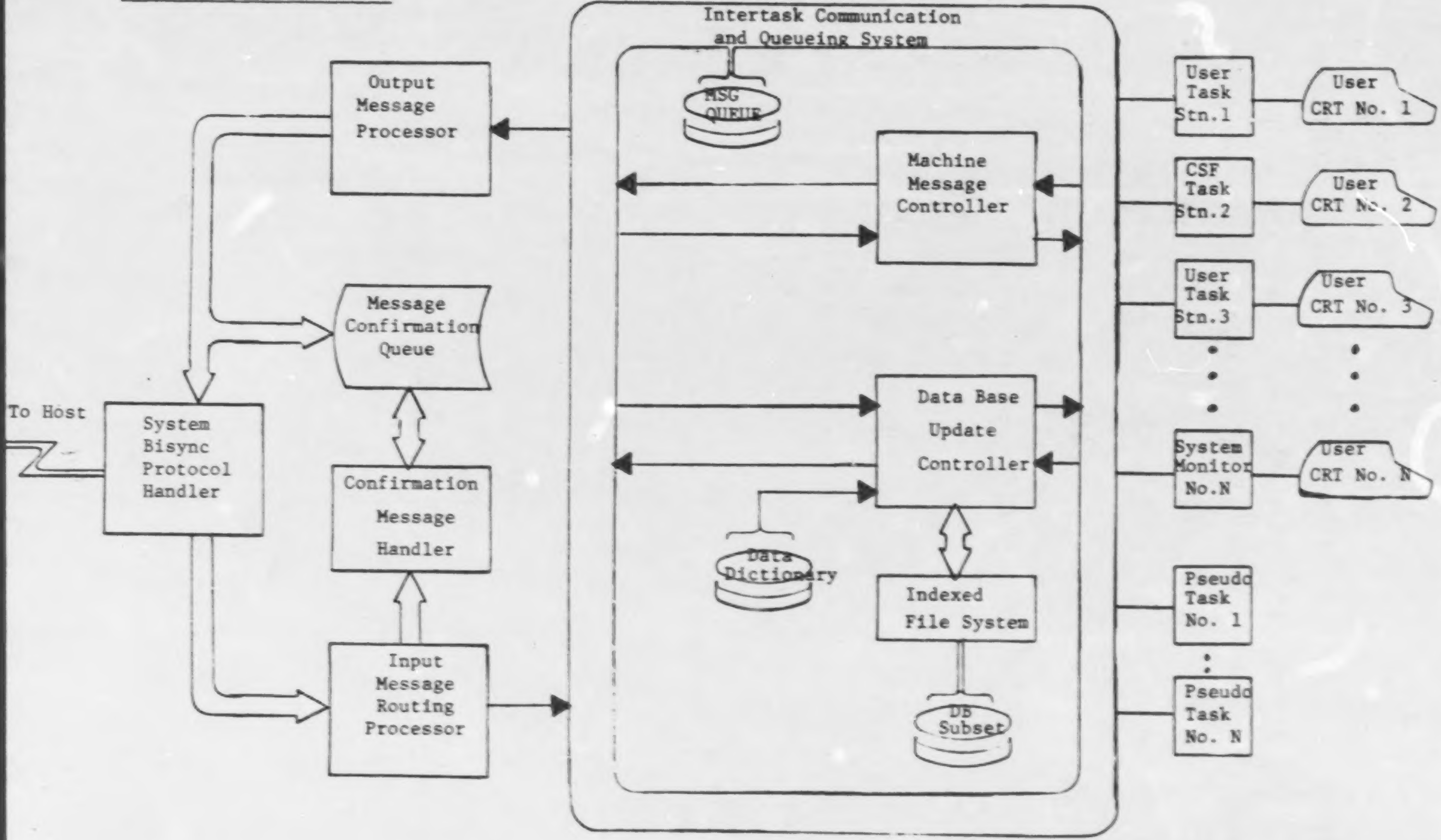
To accomplish this a monitor will be used to accept the users initial function command. This input will be used to determine the availability due to residency of the function in the distributed processor. If the function requested is not available a Communication Store and Forward task (CSF) will be started. This CSF task will accept the user input from the CRT attached to the distributed machine and send this message via a communication line to the host. The task will then wait for a response from the host outputting this response to the user's CRT. Additional input will be accepted which, if not a function request will be transmitted to the host.

If the users function request is resident, it will be started and communicate directly to the user's CRT as needed. The program or programs required to process the user's function will obtain data through the systems data management calls. These calls will determine if the data requested or updated is resident, non-resident, or redundant. If the data is non-resident or redundant an appropriate message will be sent to the host for retrieval or update and if needed a response will be waited upon. This system becomes more complicated when you require the support of multiple terminals thus requiring queueing facilities. This support requirement must be further expanded to provide for unsolicited messages from the host for redundant data updates and/or data retrieval.

The queues to support these tasks must also allow for update confirmation to insure that data is not lost due to line errors or host and/or distributive system crashes with multiple messages pending. Figure I shows the basic functional modules needed to provide these services.

As can be seen the intertask communication and queueing

COMMUNICATIONS PROCESSOR



Intertask Communication and Queueing System
MSG QUEUE
Output Message Processor
Machine Message Controller
Message Confirmation Queue
To Host
System Bisync Protocol Handler
Confirmation Message Handler
Data Base Update Controller
Data Dictionary
Indexed File System
DB Subset
Input Message Routing Processor
User Task Stn.1
User CRT No. 1
CSF Task Stn.2
User CRT No. 2
User Task Stn.3
User CRT No. 3
System Monitor No.N
User CRT No. N
Pseudo Task No. 1
Pseudo Task No. N

Figure 1

system is one of the key components in this design. This system will allow messages to be sent to a task and if needed automatically queue the message for processing by the receiver at a later time. This system will also allow messages to be sent by different paths or ports so that high priority messages may be processed in a rapid manner.

DATA MANAGEMENT

All application programs will access data through the Data Base Update Controller Module. This module will perform all user I/O requests using the Data Dictionary to determine the data location. For non-resident data, a request is sent to the Output Message Processor specifying a predetermined logical collection of data elements along with any key information needed for access. Once this message is sent the original request must be saved to be matched with an incoming message from the host. Upon the reception of a matching message from the host the data are translated to the users requested format and control returned to the user. The process for redundant or resident data is the same as any file I/O system for retrieval, accessing the resident data base for all information. Upon update, redundant data is transmitted to the host where the central data base is modified.

Update messages from the host are handled by the Machine Message Processor which calls the Data Base Update Controller for resident data base modification. Upon a valid update, a confirmation message is sent to the host confirming data base synchronization.

COMMUNICATIONS

The last remaining key element is the Communications Processor. This processor's basic task is to accept a collection of data, translate it to EBCDIC and transmit this data to the host. Incoming messages will be translated into ASCII and sent via the intertask communication system to their respective tasks. The ability to send a message requesting an update confirmation will be available. This feature will save a copy of the message to be sent until a confirmation message is received. If a confirmation message is not received within the timeout limit, the message will be retransmitted by the system.

DATA BASE SYNCHRONIZATION

The preceeding has been a brief overview of the key components to be implemented in order to provide device independent applications programming on a distributed system.

The actual process of data base synchronization in an interactive distributed environment involves various options. These options center around the concurrent modification of the same data item in separate machines. Since this is a rare occurance, the system may not provide any checks for other than multiple internal tasks, postponing synchronization until a later time. If the redundant information concurrent modification to different values is critical the system may provide exclusive usage upon update notification. This would imply the normal locking procedures in each machine plus intra-machine locking.

In order to provide this facility of intra-machine locking each update access to any redundant information must be communicated between machines. Upon an update a request for exclusive control must be transmitted and a positive or negative response waited upon before the modification can proceed. This type of synchronizing communication will place quite a heavy burden upon the single line system we would like to use at Coast. It would also imply closely coupled machines with dead lock problems. If one or the other machines went down with modification locks outstanding, what action should take place? For these reasons we propose to use a confirmation lockout procedure, which we hope will reduce actual communication, and machine dependencies.

This procedure requires that a hierarchy for updates exists between machines. The procedure requires that the primary machine refuse any update to a data element for which it has an outstanding confirmation message. The secondary machine will then notify the application program of an unsuccessful update due to a data base synchronization error. The application may then determine if a simple retry is required or if the user should be made aware of the new information before the actual update. Using this procedure, if a machine crashes, there are no lockout problems, with messages saved for later transmission.

There are other methods of synchronizing redundant data which may not require real time modifications. These methods entail notification of an event which may in turn cause multiple data elements to be modified.

To enable this feature redundant data modification must provide for resident changes without the automatic synchronizaton as described above. This possibility places the burden of synchronization upon the application program to communicate an event to the host. In this situation what you have are asynchronous routines updating their respective data bases with events passed back and forth. The usage of event modification still has the same conflict problems of normal redundant data modification. Because of this situation, the event modification will only be used for events which produce new data and/or positive updates. Positive updates are changes which are made independent of the content of the information to be modified. Positive updates also imply that the action of the event cannot be changed until the actual event has been completed. Using these criteria will insure proper data base synchronization.

Since the project at Coast is an experiment into the realm of Interactive Distributed Data Processing we hope to actually determine the rate of conflict modifications for redundant information. Event modifications will also be used as a synchronizing technique. They will be used within the first application for the transmitting of student class adds and/or drops. The usage of these two methods will hopefully provide both machine independent and rapid sychronization of data.

HOST SYSTEM

The software within the host system must include duplicates of the code required by the distributive processor for data base management and communications. In addition, the host must provide pseudo tasks to process the forwarded messages from users at the remote processor. There must be one pseudo task per CSF task within each remote processor. These tasks must be preserved over multiple I/O communications in order to save user context. Software for terminal communications within the host must also be modified so that messages intended for a local terminal are routed to the distributive processor. In addition incoming messages must be routed to each pseudo task as if they were coming from user terminals. A system such as this will enable presently developed application systems to provide functional support to the distributive processor.

The environment within the Coast Community College district provides a foundation to proceed along the design lines presented above. Figure II shows the fundamental modules needed within this system. Actual communications to the remote system will be provided through the district's main telecommunication system, ENVIRON/1. This system handles line control through line drivers or device dependent modules (DDM's). The next level of software provides translation, terminal dependent code, and user protocol handling. These higher level routines access system DDM's via assembler macros which choose which DDM to use according to parameters described during system generation.

With this system, messages from pseudo tasks will be automatically routed to the DDM handling remote processor communications. This DDM will be a match to the communications processor on the distributed machine attaching needed packet

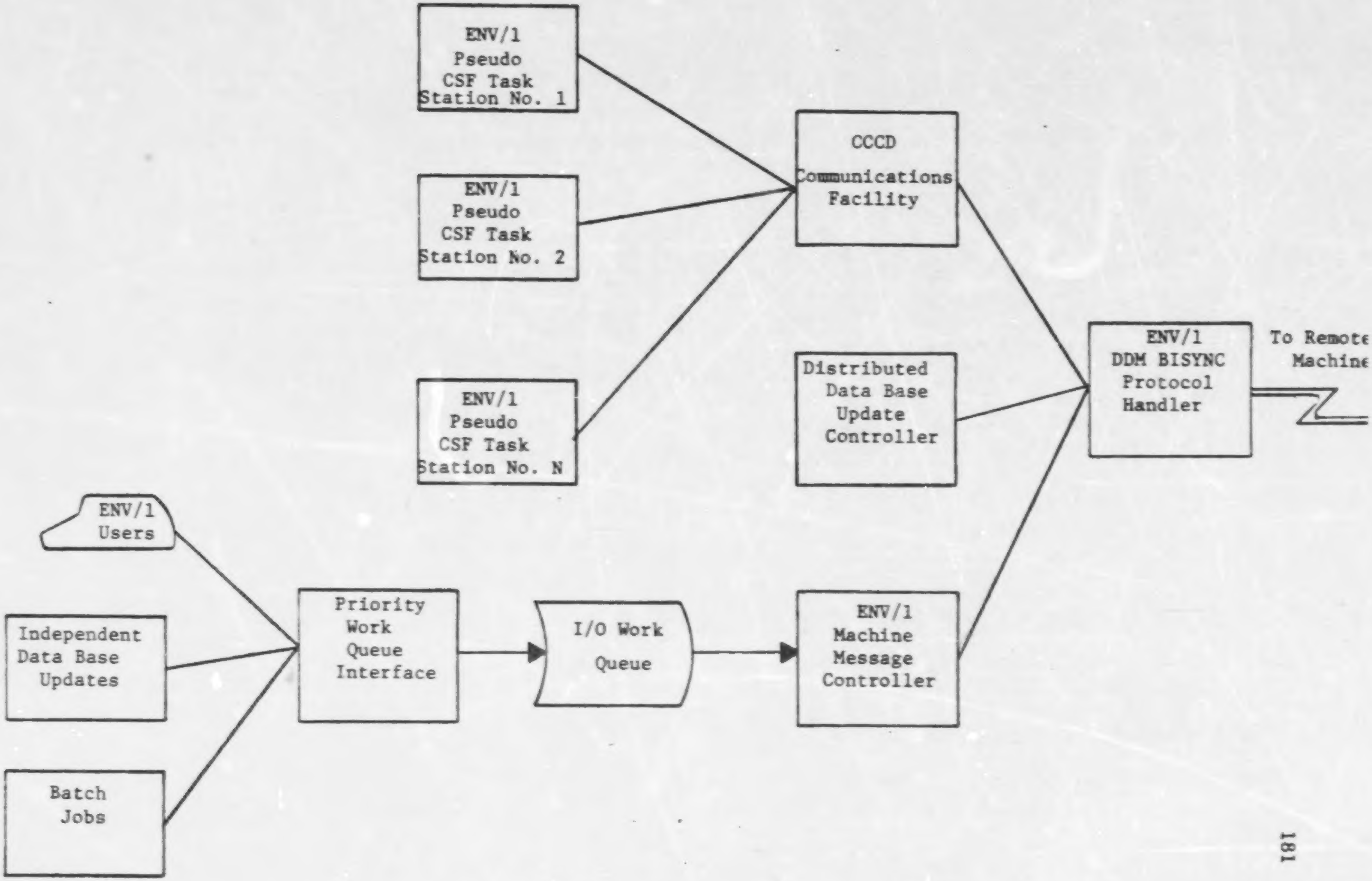

ENV/1 Pseudo CSF Task Station No. 1
ENV/1 Pseudo CSF Task Station No. 2
ENV/1 Pseudo CSF Task Station No. N
CCCD Communications Facility
Distributed Data Base Update Controller
ENV/1 DDM BISYNC Protocol Handler
To Remote Machine
ENV/1 Users
Independent Data Base Updates
Batch Jobs
Priority Work Queue Interface
I/O Work Queue
ENV/1 Machine Message Controller

Figure 11

headers and destination codes for all terminal messages. Incoming messages may be stripped of packet information and routed to the tasks via the low level macros for reading data from a DDM.

All the above processing has been for store and forward type communication and will go through the high level Communications Facility used by all applications programs. Machine messages and data base updates or requests will also use pseudo tasks written to process a particular type of request. These modules will use the direct DDM access macros, skipping code and terminal control processing of the Communication Facility.

Data Base Management on the district's host machine is an element oriented, centralized system. This system will require a dictionary as in the distributed machine but will place all updates in a disk queue to be processed by the teleprocessing system. This procedure insures that both batch and online updates to redundant information will be sent to the correct remote machine. A task running under the online system will read the information placed on the data base queue and forward it to the DDM after the correct formatting. Depending upon actual experimental results and system loads, there may be multiple asynchronous tasks running concurrently within the host processing various messages from each distributed processor.

CONCLUSION

Much design work still is required to provide implementation plans. This work has been postponed until an actual physical machine is selected. This selection process has been conducted over the past year and has influenced our design and overall system goals. The system specification developed reflects the realities of the present mini-computer offerings, our total system requirements, along with current project economics. The Coast mini-computer review indicates a truly interactive distributed system as herein described is not currently available. In addition, a complete computing system to enable implementation is an elusive phantom. There is always some aspects of the ideal system missing and usually this aspect is crucial. Based upon these considerations, there are four areas which will provide our major guidelines for selection, exclusive of monetary considerations. These areas are; Intertask Communication, Single Station Concept, Memory Utilization and Sharing, and the availability of high level languages.

The Intertask Communication should be as described previously, providing automatic disk queueing for messages pending. The concept of Single Station Programming relates to application programs dealing with only one terminal even though multiple terminals may be using the program concurrently. This implies automatic routing and context separation for each terminal by a monitor or operating system. Memory utilization must provide for the total logical usage to be greater than the actual memory available. Program sharing, paging instead of swapping are also of prime importance in this area. The availability of high level languages which operate in these environments is important for efficient and rapid development, along with transportability to other machines.

Hopefully a machine matching these basic requirements will be submitted. Once this is accomplished, detailed design may proceed. In the interim, work is continuing on packet formats, message types, data dictionary formats, and all the other details which you will find are required of the user if you wish to dive into the distributive processing ocean.

COMPUTER INDEXING AND MICROGRAPHICS
AN INTEGRATED SYSTEM APPROACH

Michael L. Maas
LONG BEACH COMMUNITY COLLEGE DISTRICT
Long Beach, California

The integration of a computer index system with a 16 mm cartridge microfilm system is currently being implemented at Long Beach City College. Approximately 7.5 million student records have been filmed and indexed using this system.

The system is predicated on the concept that a micrographics system is only as good as its index system, and the most efficient index system is one that is computer generated.

The system has the added capability to accept COM generated documents as well as a complete interface with on-line retrieval systems.

OVERVIEW

Long Beach Community College District is a multi-campus community college with two main campuses, five extension campuses, and seventy satellite centers. Current enrollment is 32,000 students per semester. Since its inception in 1927, student records and files have been created in ever increasing quantities. In an effort to eliminate and effectively manage all student records of the College, a review of the entire records system was made by the Admissions and Records staff of the College during the 1974-75 school year. One of the conclusions of this study was that a systematic microfilming of many of the student records was essential for proper office management. In addition, a records retention manual had to be established for the identification of all records and in turn legal procedures established for the necessary retention, microfilming, and positive destruction of appropriate records.

With these guidelines in mind, the College began the implementation of a total records management system with the 1975-76 fiscal year. A major component of this system was the microfilming and indexing of approximately 7.5 million records.

INTRODUCTION

In the development of Long Beach City College's micrographics system, numerous micrographic systems were reviewed by the Admissions and Records staff. In systematically studying the systems, six types of systems were readily apparent. These were as follows:

a. Microfiche System

b. Roll Film System

c. 16 mm Cartridge System

d. Aperture Card System

e. Ultrafiche System

f. Miracode System

After careful evaluation of all systems, it was determined that a 16 mm Cartridge System in concert with COM generated microfiche was the most appropriate system for the various microfilming applications envisioned for the College. The reasons for this decision were as follows:

a. The Cartridge System provides the opportunity for the best interface with data processing in terms of computer output microfiche and key-to tape indexing procedures.

b. The blip encoding index procedure available on Cartridge Systems will allow for accurate indexing and retrieval of all documents.

c. The cost of the Cartridge System is either less than or equivalent to that of the other systems.

d. Personnel training and operation of equipment requires only a moderate level of training.

e. Total interface with a COM generated transcript system is possible in the near future.

f. Storage space for all student records will be reduced by at least 95 per cent.

It is apparent that portions of some systems reviewed may have advantages over given portions of the 16 mm Cartridge System. However, the entire system must be considered and a conglomeration of various pieces of each system is neither feasible nor applicable to a total records management system.

EQUIPMENT

To implement the micrographics system for Long Beach City College, the following pieces of equipment were required. The total cost of the equipment was $53,000 when purchased in February 1976.

a. 1 16 mm Cartridge, Rotary Microfilm Camera

b. 1 16 mm Cartridge, Planetary Microfilm Camera

c. 5 16 mm Cartridge Reader/Printers

d. 12 48X Microfiche Readers

e. 1 16 mm Cartridge Reader

f. Microfilm Storage Cabinets to store approximately 2,400 cartridges of microfilm.

FILMING PROCEDURES

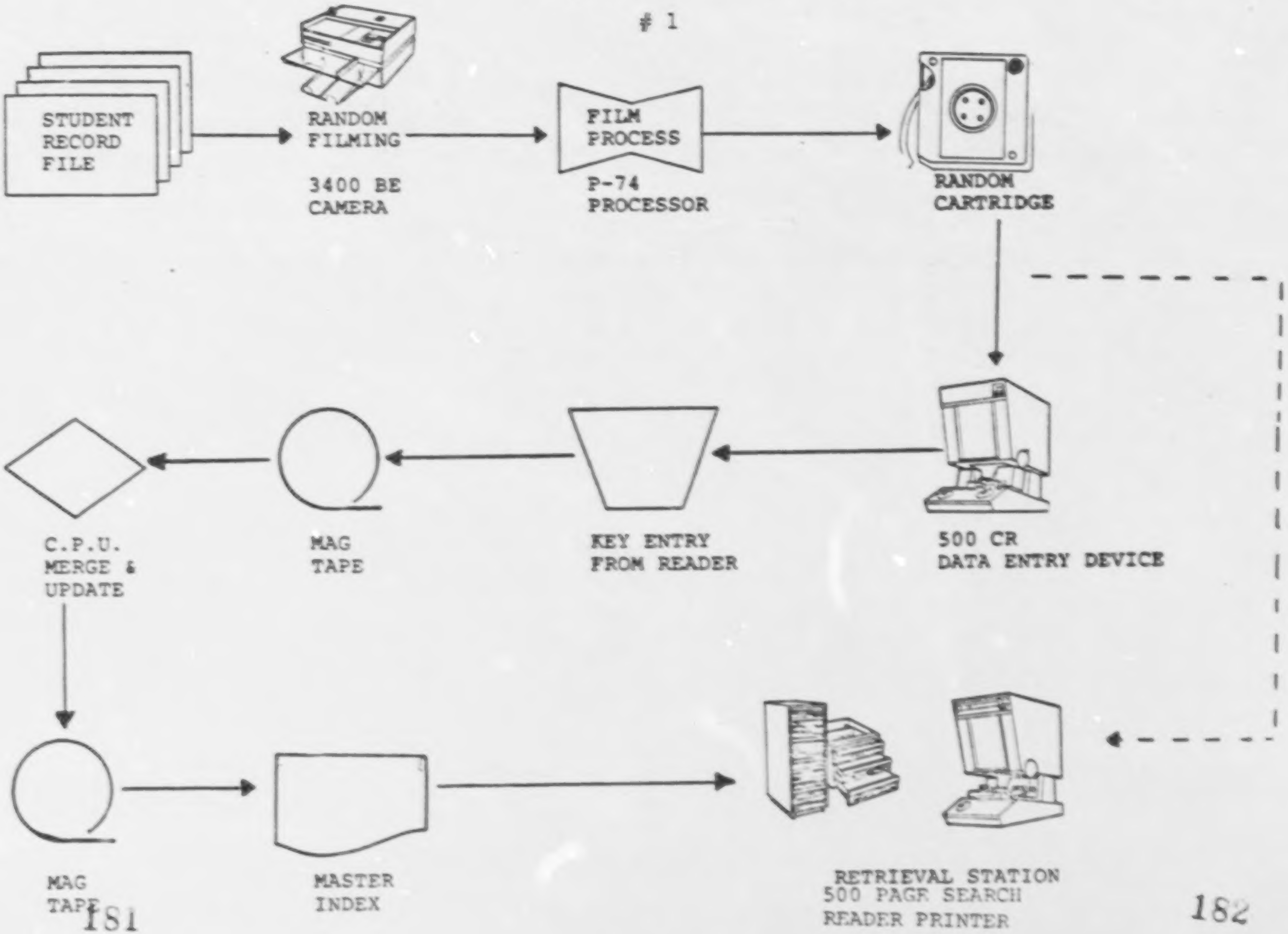
As mentioned in the introduction, approximately 7.5 million records were microfilmed. The determination was made prior to filming as to whether a manual or computer generated index was required for each type of document filmed.

In addition, detailed filming procedures were developed to allow the microfilm technician to determine which camera to use and what format to follow. As an example of the planning involved, the next few pages illustrate the schematic flow of documents for filming as well as the projected volume and timeline to follow.

FLOW CHART

STUDENT RECORD FILE

1

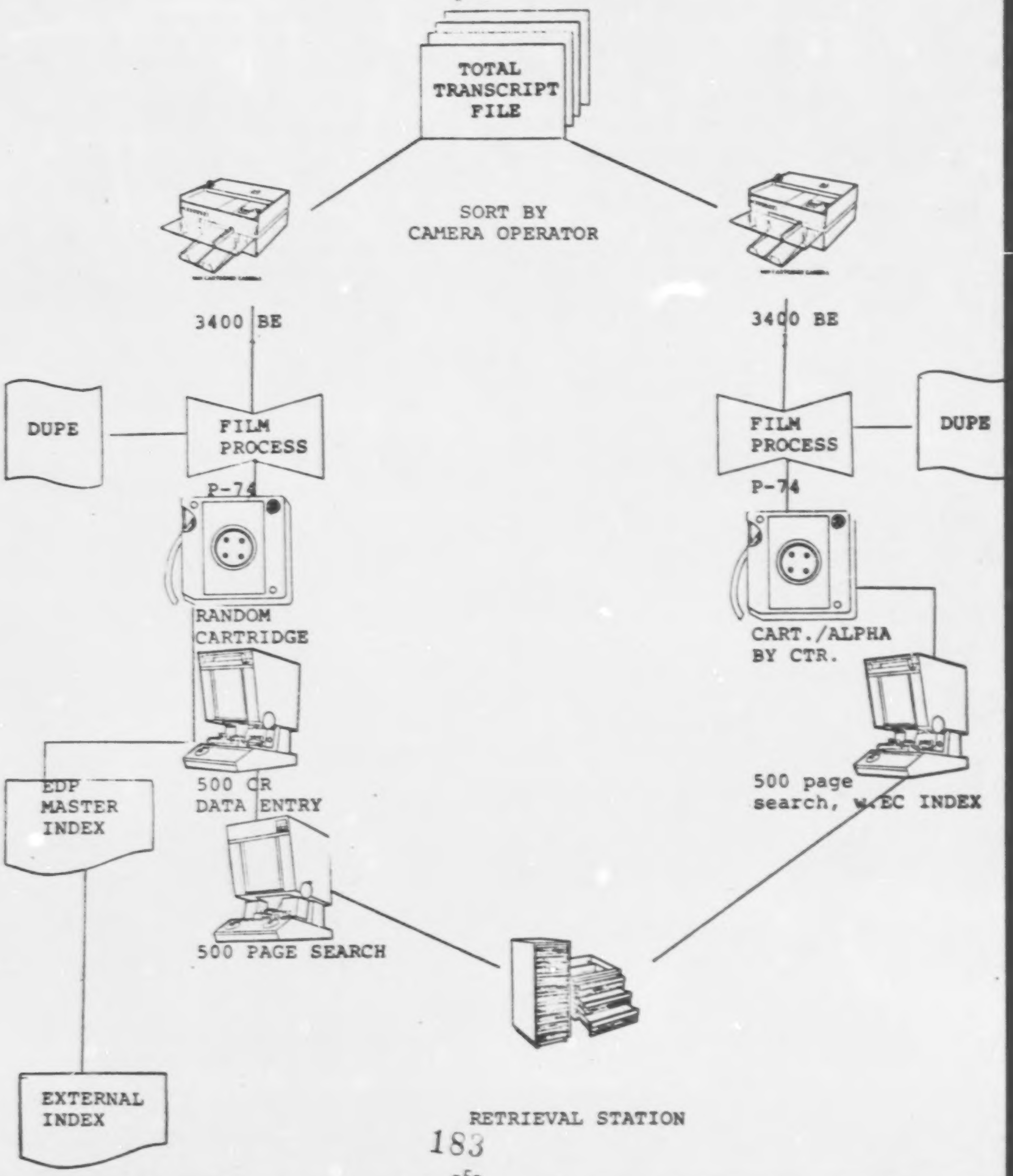

STUDENT
RECORD
FILE
RANDOM
FILMING
3400 BE
CAMERA
FILM
PROCESS
P-74
PROCESSOR
RANDOM
CARTRIDGE
500 CR
DATA ENTRY DEVICE
KEY ENTRY
FROM READER
MAG
TAPE
C.P.U.
MERGE &
UPDATE
MAG
TAPE
MASTER
INDEX
RETRIEVAL STATION
500 PAGE SEARCH
READER PRINTER

FLOW CHART

ADMISSIONS AND RECORDS

DOCUMENTS

2


TOTAL
TRANSCRIPT
FILE
SORT BY
CAMERA OPERATOR
3400 BE
3400 BE
DUPE
FILM
PROCESS
FILM
PROCESS
DUPE
P-74
P-74
RANDOM
CARTRIDGE
CART./ALPHA
BY CTR.
EDP
MASTER
INDEX
500 CR
DATA ENTRY
500 page
search, w/EC INDEX
500 PAGE SEARCH
EXTERNAL
INDEX
RETRIEVAL STATION

MICROFILMING TIMELINE CONTROL

DOCUMENT	WHEN TO MICROFILM	EXPECTED VOLUME	FILMING COMMENTS
Instructors' Rollbooks	2 yrs. after the semester that grades are issued	2,600 / semester	The PCC/EXT and LAC Rollbooks must be interfiled alphabetically before filming. Each cartridge will then be by semester, instructor, and chronological according to section numbers.
Program Cards	Immediately after the semester in which they are created	33,000 / semester	Film both sides and interfile with Change of Program Card. Will separate according to campus, i.e., LAC, PCC, EXT./SAT.
Grade Slips	After each semester	33,000 / semester	Will be generated via COM beginning with the Fall semester, 1975.
Transcripts	Each day as produced	8,000 / year	Film each day as produced so as to update the grade slip/transcript system. Index at least twice per semester
Change of Grade Forms	Each semester	300 / semester	Film alphabetically by student name. Corrections made to transcript system as well.
Change of Program Cards	Immediately after the semester in which they are created	10,000 / semester	Film as part of the Program Card system. (See above.)

GRADE SLIP / TRANSCRIPT SYSTEM

TIME	IMMEDIATELY AFTER END OF THE SEMESTER			ANYTIME	COMMENTS
FUNCTION	Data Processing produces a grade slip for every student and delivers the PCC, LAC, and two combined decks - in alpha order by student name - to Records Office, LAC	Records Office distributes decks as follows: 1. Copy 1 of each deck to Transcripts Office. 2. Copy 2 of one combined deck and Copy 2 of PCC deck to PCC Govt. Desk. 3. Copy 2 of 2nd combined deck and Copy 2 of LAC deck to LAC Govt. Desk. 4. Copy 3 of one combined deck and Copy 3 of PCC deck to PCC Records Clerk. 5. Copy 3 of 2nd conbined and Copy 3 of LAC deck to LAC Records Office.	Update Microfilm Cartridge System and Index via COM	As transcripts are requested grade slips are referenced and data typed on transcript or, if no transcript, a transcript is typed. Microfilm all transcripts generated for inclusion in updated index.	1. Each semester DPS sends grade tape to COM Service Bureau for new cartridges. Also DPS generates a new index that is placed on microfiche. 2. By 1978, it is planned to have 3 years of grades on-line, and then go to COM after the 3rd year.
LOCATION	Data Processing Services	Records Office - LAC	COM Service Bureau	Transcripts Office	

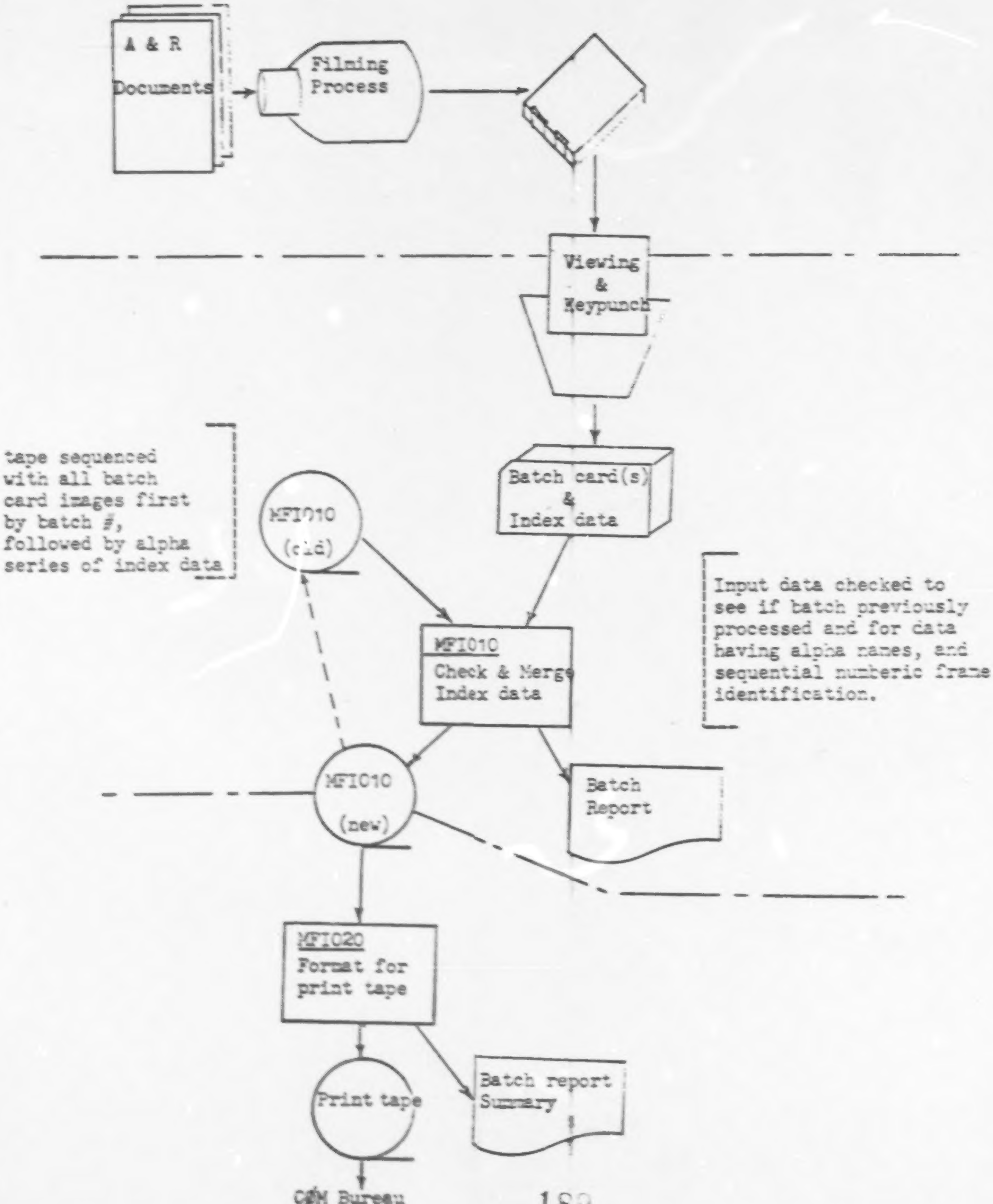
COMPUTER INDEX SYSTEM

The key to the microfilm/transcript system is the index generated by data processing. This index, created after the documents have been filmed, is generated via key punching and batch processed. The format of the output is microfiche.

The index system allows for all documents on file for a given student to be grouped chronologically and listed under the student's name in sequence. Three identifiers, name, birthdate, and student number have been used in generating the index.

Included in this section are the details of the program design, parameters used for indexing, a flow chart description, and log sheets. It is hoped that this information will be of assistance to those systems designers who might be considering a similar system.

Microfilm Index Process Flow


A & R
Documents
Filming
Process
Viewing
&
Keypunch
Batch card(s)
&
Index data
MFI010
(old)
MFI010
Check & Merge
Index data
MFI010
(new)
Batch
Report
MFI020
Format for
print tape
Print tape
Batch report
Summary
CØM Bureau

tape sequenced with all batch card images first by batch #, followed by alpha series of index data

Input data checked to see if batch previously processed and for data having alpha names, and sequential numberic frame identification.

MICROFILM INDEX PROCESS FLOW DESCRIPTION

1. The individual document pages are photographed onto microfilm cartridges.

2. A batch sheet is completed for each film cartridge. The available batched cartridges are then sent to the data processing department c/o data control. The cartridges will then go to the keypunch area for viewing and index data selection.

3. Within the keypunch area, the cartridges are processed by producing a batch card which shows the batch number, col. 1-6

   originating location, col. 9-11
   document description, col. 13-38
   date the batch was received, col. 39-44, MMDDYY
   date keypunch started the batch, col. 45-50 MMDDYY
   document count, col. 61-67
   keypuncher's identification code, col. 77-78
   and batch card identification code, col. 79-80

   When the batch of data is merged into the tape file, the program adds two fields to the tape record of the batch card. The added fields are

   date the batch merged, col. 50-56, MMDDYY
   and count of the cards in the batch, col. 57-60.

   Behind the batch card, are placed the detail index data cards for the cartridge. Each detail card contains the

   student name, col. 1-23, Last first middle initial
   birthdate, col. 24-29, MMDDYY
   social security or student-ID number, col. 30-38
   semester code, col. 39

semester year, col. 40-41

document type, col. 42

cartridge number, col. 43-46, Z/RADJ

frame number, col. 47-50, Z/RADJ

and microfilm detail line code, col. 79-80

The detail cards are expected to be in ascending frame number sequence. Checking is done by MF1010 to ensure a proper microfilm detail line code, a completely alphabetic name, and a completely numeric cartridge and frame indetification.

4. The keypunch batches are sent to data control for collection and merger into the existing microfilm index file. Multiple batches may be concatenated for merger at a given computer submittal. The tapes and data cards should be saved long enough to provide 3 generations of tape for backup. After each merger a processed batch report is produced along with a list of identified data exceptions. The data exceptions are not removed from the index. If corrections are to be made, the new index line must be re-submitted as part of a "corrections" batch. At least one copy of the processed batch report should be returned to keypunch to aid in work control.

5. The completely merged microfilm data tape is used as input to a program to format the data onto an output print page which is moved to a print tape. The print tape will be used by an off site company to produce microfiche pages.

The print tape is 9 track, EBCDIC characters, and unlabeled. Records are 133 characters long, blocked 10. The first character of each record is the carriage control byte.

The print tape may be checked by use of the program PRINTAPE. As many pages as needed may be printed.

6. The Dean of Admissions and Records is the contact person to receive the print tape for off-site transferral.

L B C C SETUP SHEET

STEP 1 OF 1 DATE 8/6/76

PROG ID MF1010 EST. TIME 20 Min. PROG. DESC. Check & Merge Microfilm Index Data SYSTEM NO.

UNIT	SYMBOLIC NAME	MNEMONIC NAME	I/O	MEDIUM	FILE - ID	SOURCE/ DESTINATION	VER.	VOLUME SERIAL/S	CONTROL DESK PROVIDES
180	SYS019	Tape-In	I	Tape	'MF1010'	CNT. DSK			***
181	SYS022	Tape-Out	0	Tape	'MF1010'	Scratch/ CNT. DSK			Label
132	SYS001	Sort-File	I/0	Disk	'Work Area'				
00C	SYS004	Cards-In	I	Card					***
00C	SYS005	Print-Out	0	Print					

CARRIAGE CONTROL TAPE STD

SPACING 6 ☒ 8 ☐ LINES PER INCH

TYPE FORMS Stock #COPIES 3

OPSCAN RIBBON ☐

FORMS ALIGNMENT: STANDARD ☐ SPECIAL ☐ (SEE BELOW)

REPORT PROCESSING

CONTROL CARD FORMAT

PRINT CHAIN QN ☐ RN ☐

OFFLINE ACTION:

BURST ☐ DECOLLATE ☐ STRIP ☐

PLACE IN BOXES ☐

SPECIAL INSTRUCTIONS:

OPERATOR:

LBCC SETUP SHEET

STEP 1 OF 1

DATE 8/6/76

PROG ID MF1020 EST. TIME 20 Min. PROG. DESC. Format Microfilm Indes Tape to Print Tape SYSTEM NO.

UNIT	SYMBOLIC NAME	MNEMONIC NAME	I/O	MEDIUM	FILE - ID	SOURCE/ DESTINATION	VER.	VOLUME SERIAL/S	CONTROL DESK PROVIDES
181	SYS019		I	Tape	'MF1010'	CNT. DSK	NEW		***
182	SYS022	Printape	O	Tape	Unlabeled	Scratch/ CNT. DSK			Label
00E	SYS005		O	Print					

CARRIAGE CONTROL TAPE STD

SPACING 6 ☒ 8 ☐ LINES PER INCH

TYPE FORMS Stock #COPIES

OPSCAN RIBBON ☐

FORMS ALIGNMENT: STANDARD ☐ SPECIAL ☐ (SEE BELOW)

REPORT PROCESSING

CONTROL CARD FORMAT

PRINT CHAIN QN ☐ RN ☐

OFFLINE ACTION:

BURST ☐ DECOLLATE ☐ STRIP ☐

PLACE IN BOXES ☐

SPECIAL INSTRUCTIONS:

OPERATOR:

BATCH NUMBER ____________________

DOCUMENT SOURCE ____________________ RETURN TO ____________________

TYPE OF DOCUMENT ____

DOCUMENT COUNT ____________________ REVISED COUNT ____________________

DATE OF DELIVERY ____________________ DATE RECEIVED ________ DATE RETURNED ________

PREPARED BY ____________________ ACTION TAKEN ____________________

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

MULTIPLE-CARD LAYOUT FORM

(ORANGE CARDS)

GX24-6599-0
Printed in U.S.A.

Company Micro-film

Application Batch Identification Card

by

Date Aug 1976/ Feb 1973

Job No.

Sheet No.

Batch No.	SUF		Loc.		Description of Documents	Date Batch Received	Date Keypunch Started	Date Merged To Tape	# Cards In Batch	Document Quantity		KP Code		BB
9 9 9 9 9 9	9	9	9 9 9	9	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	9 9 9 9 9 9	9 9 9 9 9 9	9 9 9 9 9 9	9 9 9 9	9 9 9 9 9 9 9	9 9 9 9 9 9 9 9 9	9	9	9 9
1 2 3 4 5 6	7	8	9 10 11	12	13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38	39 40 41 42 43 44	45 46 47 48 49 50	51 52 53 54 55 56	57 58 59 60	61 62 63 64 65 66 67	68 69 70 71 72 73 74 75 76	77	78	79 80

Computer generated
Data Fields

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

MULTIPLE-CARD LAYOUT FORM

GX24-6599-0
Printed in U.S.A.

Company Microfilm Index Data

Application Student Files Filming by ______ Date 8/6/76 Job No. ______ Sheet No. ______

Last name	First name	MI	Birthdate MM	DD	YY	Soc. Sec. or Student #	Semester	Year		Cartridge number	Frame number		MF
9 9 9 9 9 9 9 9 9 9 9 9	9 9 9 9 9 9 9 9 9 9	9	9 9	9 9	9 9	9 9 9 9 9 9 9 9 9	9	9 9	9	9 9 9 9	9 9 9 9	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	9 9
1 2 3 4 5 6 7 8 9 10 11 12	13 14 15 16 17 18 19 20 21 22	23	24 25	26 27	28 29	30 31 32 33 34 35 36 37 38	39	40 41	42	43 44 45 46	47 48 49 50	51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78	79 80

(Document type

(Semester Code:
Summer 1 = 1 Fall = 3
Summer 2 = 2 Spring = 4

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

NAME, LAST	FIRST	MI	DOB	ID NUMBER	S/YR	INDEX CODE
ABEL	HERBERT	H		440-12-9203	3/41	A-0001-0513
ABEL	ID	C		564-24-5246	3/43	A-0001-0515
ABEL	JAMES	J			4/50	G-0006-0516
ABEL	JOHN	F		53-28545	3/53	G-0134-1237
ABEL	MARIE	E		51-23581	3/52	G-0076-1112
ABEL	MARIE	E		51-23581	3/52	G-0076-1110
ABEL	MARIE	E		51-23581	3/52	G-0076-1109
ABEL	MARIE	E		51-23581	3/52	G-0076-1111
ABEL	MARIE	E		51-23581	4/52	G-0076-1113
ABEL	RONALD	J			4/48	A-0001-0517
ABEL	RONALD	J			4/48	A-0001-0517
ABEL	RONALD	J	05/29/29		4/48	A-0001-0518
ABELEIN	CORNELIA	B			/	A-0001-0519
ABELEIN	CORNELIA	B			/	A-0001-0519
ABELEIN	CORNELIA	B		50-15666	/	G-0032-3406
ABELEIN	CORNELIA	B		50-15666	4/51	G-0032-3407
ABELEIN	CORNELIA	B		50-15666	4/51	G-0032-3405
ABELL	DUFF	K		459-12-7834	1/42	A-0001-0520
ABELL	DUFF	K		459-12-7834	1/42	A-0001-0520
ABELL	E	A		50-28722	4/52	G-0045-1533
ABELL	ELFREDA	O		50-28722	4/52	G-0045-1534
ABELL	ELFREDA	O		50-28722	4/53	G-0045-1518
ABELL	ESTHER	J			3/45	A-0001-0522
ABELL	ESTHER	J			4/45	A-0001-0522
ABELL	LEON				3/48	A-0001-0526
ABELL	LEON				3/48	A-0001-0526
ABELL	LEON		10/07/12		3/48	A-0001-0527
ABELL	LEON	H			1/46	A-0001-0525
ABELL	LEON	H			2/46	A-0001-0525
ABELL	LEON	H			2/46	A-0001-0529
ABELL	LEON	H			2/46	A-0001-0525
ABELL	LEON	H			3/47	A-0001-0530
ABELL	LEON	H			3/47	A-0001-0532
ABELL	LEON	H			3/47	A-0001-0532
ABELL	LEON	H			1/48	A-0001-0530
ABELL	LEON	H		51-08248	3/51	A-0001-0523
ABELL	LEON	H		51-08248	3/51	G-0065-2069
ABELL	LEON	H		503-14-4192	1/46	A-0001-0529
ABELL	LEON	H		503-14-4192	1/46	A-0001-0528
ABELL	LEON	H		51-08248	3/51	A-0001-0523
ABELL	LEON	H	10/07/12	51-08248	3/51	A-0001-0524
ABELL	LEON	H	10/07/22		3/47	A-0001-0531
ABELL	LEON	H	10/07/22		3/47	A-0001-0533
ABELL	OLGA			50-28722	4/51	G-0045-1535
ABELL	OLGA			50-31912	4/51	G-0046-0072
ABELL	OLGA		05/03/81		3/50	A-0001-0542
ABELL	OLGA	E			/	A-0001-0540
ABELL	OLGA	E			3/49	A-0001-0540
ABELL	OLGA	E		50-28722	3/50	G-0045-1526
ABELL	OLGA	E		50-28722	3/50	G-0045-1524
ABELL	OLGA	E		50-28722	3/50	G-0045-1525
ABELL	OLGA	E		50-28722	3/50	G-0045-1523
ABELL	OLGA	E		50-28722	3/50	G-0045-1529
ABELL	OLGA	E		50-28722	3/51	A-0001-0535
ABELL	OLGA	E		50-28722	3/51	G-0045-1532
ABELL	OLGA	E		50-28722	3/51	G-0045-1531
ABELL	OLGA	E		50-28722	4/51	G-0045-1536
ABELL	OLGA	E		50-28722	4/51	G-0045-1530
ABELL	OLGA	E		50-28722	3/52	G-0045-1528
ABELL	OLGA	E		50-28722	3/52	G-0045-1527
ABELL	OLGA	E		50-28722	3/53	G-0045-1520
ABELL	OLGA	E		50-28722	3/53	G-0045-1522
ABELL	OLGA	E		50-28722	3/53	G-0045-1521
ABELL	OLGA	E		50-31912	4/51	G-0048-0073
ABELL	OLGA	E		50-28722	3/51	A-0001-0535

NAME, LAST	FIRST	MI	DOB	ID NUMBER	S/YR	INDEX CODE
ABELL	OLGA	E	05/03/81		3/50	A-0001-0537
ABELL	OLGA	E	05/03/81		3/50	A-0001-0541
ABELL	OLGA	E	05/03/81		3/50	A-0001-0534
ABELL	OLGA	E	05/03/81		3/50	A-0001-0542
ABELL	OLGA	E	05/03/81		3/50	A-0001-0534
ABELL	OLGA	E	05/03/81		3/50	A-0001-0537
ABELL	OLGA	E	05/03/81		3/50	A-0001-0536
ABELL	OLGA	E	05/03/81		3/50	A-0001-0541
ABELL	OLGA	E	05/03/81		3/53	A-0001-0536
ABELL	OLGA	S		50-28722	4/53	G-0045-1519
ABELL	ROBERT	E		545-26-0703	1/42	A-0001-0538
ABELL	ROBERT	E		545-26-0703	1/42	A-0001-0538
ABELL	VIRGINIA				1/52	G-0052-1454
ABELL	VIRGINIA				1/52	G-0052-1457
ABELL	VIRGINIA				1/52	G-0052-1456
ABELL	VIRGINIA			50-60055	1/51	G-0052-1460
ABELL	VIRGINIA			50-60055	4/51	G-0052-1458
ABELL	VIRGINIA			50-60055	4/56	G-0052-1459
ABELL	VIRGINIA		08/06/31		1/51	A-0001-0543
ABELL	VIRGINIA		08/06/31		1/51	A-0001-0543
ABELLA	JOHN	L		567-10-6732	3/44	A-0001-0544
ABELLA	JOHN	L		567-10-6732	3/44	A-0001-0546
ABELLA	JOHN	L		567-10-6732	3/44	A-0001-0544
ABELLA	JOHN	L		587-10-6732	3/44	A-0001-0546
ABELN	ANNA	B		51-25462	1/52	G-0078-1328
ABERCROMBIE	BOLLING	G		570-20-7099	4/42	A-0001-0547
ABERCROMBIE	FAY	E		53-36450	4/54	G-0137-1651
ABERCROMBIE	GEORGE	C		51-39004	1/52	A-0001-0549
ABERCROMBIE	GEORGE	C		51-39004	1/52	G-0082-0188
ABERCROMBIE	GEORGE	C		51-39004	4/52	G-0082-0189
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ABERCROMBIE	HARRY	L		51-23255	4/52	A-0001-0551
ABERCROMBIE	HARRY	L		53-36451	4/54	G-0137-1650
ABERCROMBIE	HARRY	L	05/08/03	5 -	4/52	A-0001-0552
ABERCROMBIE	HARRY	L	51/23/25	5 -	4/52	A-0001-0551
ABERCROMBIE	HILTON	S			4/49	A-0001-0553
ABERCROMBIE	IDADELL			50-32555	4/51	G-0049-0587
ABERCROMBIE	IDADELL	D		50-10181	3/50	G-0024-2422
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ABERCROMBIE	JOHN			550-14-8286	2/44	A-0001-0555
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ABERCROMBIE	JOHN	O		525-07-2972	1/43	A-0001-0557
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ABERCROMBIE	MABEL				3/51	A-0001-0559
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ABERCROMBIE	ROBERT	L		554-26-5609	3/41	A-0001-0560
ABERCROMBIE	SHIRLEY	A			4/49	A-0001-0563
ABERCROMBIE	SHIRLEY	A			4/49	A-0001-0562
ABERCROMBIE	SHIRLEY	A			4/49	A-0001-0563
ABERCROMBIE	SHIRLEY	A			4/49	A-0001-0562
ABERCROMBIE	SHIRLEY	A		50-00795	3/53	G-0012-0506
ABERCROMBIE	SHIRLEY	A		50-00795	3/53	G-0012-0507
ABERCROMBIE	SHIRLEY	A		50-00795	3/53	G-0012-0504
ABERCROMBIE	SHIRLEY	A		50-00795	3/53	G-0012-0505
ABERCROMBIE	SHIRLEY	A		50-00795	1/54	G-0012-0534
ABERCROMBIE	SHIRLEY	A		50-00795	1/54	G-0012-0533
ABERCROMBIE	SHIRLEY	A		50-00795	3/54	G-0012-0531
ABERCROMBIE	SHIRLEY	A		50-00795	3/54	G-0012-0530
ABERCROMBIE	SHIRLEY	A		50-00795	3/54	G-0012-0525
ABERCROMBIE	SHIRLEY	A		50-00795	3/54	G-0012-0526
ABERCROMBIE	SHIRLEY	A		50-00795	4/54	G-0012-0535
ABERCROMBIE	SHIRLEY	A		50-00795	4/54	G-0012-0532
ABERCROMBIE	SHIRLEY	A		50-00795	4/55	G-0012-0517

IMPLEMENTATION SCHEDULE

The following timeline is presented as a guideline for systems planning. This was the actual timeline for development of the system at Long Beach City College.

DATE	ACTIVITY
October 17, 1975	Microfilm Proposal and Retention Manual presented to Vice President Student Personnel Services.
October 23, 1975	Review of Proposal by the President's Cabinet.
November 3, 1975	All requisitions processed and announcement for bids prepared.
November 21, 1975	Closing Dates for Bids.
December 1, 1975	Purchase Orders issued for Equipment.
March 1, 1976	Training of film operators begin.
Jan. 5 - June 1, 1977	Backlog of all Program Cards, Rollbooks, Status Cards and Miscellaneous filming completed.
June 1 - Dec. 1, 1977	Transcript filming completed; index systems completed.
Dec. 1, 1977	Microfilm, COM transcript System in operation.

ASSESSING DATA PROCESSING PAYOFF

by
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Data processing and information systems must be responsive to the needs of management at all levels. A decision to commit to a new hardware, software, or application involves more than the economic impact on a single department. Issues such as data privacy, security, timeliness, prestige, changing technology, etc., influence the action taken. Benefit Analysis, as discussed in this paper, factors these into the decision process, as well as priorities. It is shown how considerations of the total institution which differ from those of the service unit may affect a decision. Applications of the technique in making decisions are described.

ASSESSING DATA PROCESSING PAYOFF

I. Introduction

A central issue in the resource allocation problem is a determination of the net advantages to be gained through the expenditure of resources. Specifically, the decision of whether a given system should be computerized or whether it should be operated in a clerical mode, or perhaps not operated at all, is highly dependent upon a determination of the relative costs and benefits associated with each mode of operation.

A study of all requests for new system developments should be made in order to provide an economic justification prior to system development. In assessing the payoff for a system we are concerned with relative costs and relative returns. That is, we "net out" the costs associated with the old system versus the estimated costs relative to the new system; and in a like manner we measure the benefits of the old system against the benefits of the new system.

The net return due to the conversion or development of any system for data processing may be defined as:

1. The net cost saving of the new system.
2. The value of returns gained by the new system.

It is not necessary that a cost/benefit advantage be realized in any specific month; rather, an analysis of costs and benefits over the projected "life" of the system is the important criteria (usually these cost/benefits are converted to a per year base). For example, it may be difficult to show a net advantage to making records of items in inventory available through a teleprocessing system during the first few months of operation; but, it would be improper to ignore the long range benefits which could occur if a large number of terminals capable of accessing this data could be reasonably projected.

In formalized cost/benefit analyses, each new application must be viewed as different with regard to which of the costs and benefits are significant. For the analysis, it is necessary first to identify the key considerations in determining costs and benefits. A list of elements commonly encountered in analyzing data processing applications can be developed. This list would aggregate expenditures for Hardware, Software, Personware, Material, Facilities, Finances, and Support.

II. ANALYSIS OF COMPARATIVE COST

It is necessary to prepare a comparative analysis of the costs associated with the computerized system being proposed and comparable systems which may accomplish the same tasks. For a new system, the installation and conversion costs would be included. These are those costs which would be incurred once, and only once, during the development and installation of the computerized system. We would expect these costs to include:

1. Hardware - Computer, 1/0, Auxiliary devices (disk drive, tape drive, etc.)
2. Communication lines and interface equipment.
3. Support Devices - OCR, COM, MICR, Bursters, etc.
4. Computer time
5. Special software - Data Base, Retrieval, Application, Administrative
6. Systems design and development.

7. Programming.
8. Testing and debugging.
9. Input keypunch, key to disk, key to tape, OCR, MICR, terminal.
10. Documentation.
11. Training and Education includes travel, site inspection, classes.
12. Material (cards, forms, tape, film and chemical for COM, disc).
13. Facility alterations or additions.
14. Finance.
15. Other (e.g. overhead).

Each of these elements can, in themselves, be the subject of extensive analysis. Figure 1 shows a number of hardware components that interact in the analysis.

While conversion costs are paid only once, it is entirely reasonable to determine a rate of interest and to capitalize or distribute such costs over a longer period of time than the conversion period itself. It is important to distribute conversion costs over a period of years in order that they might be compared with operating costs which are estimated on a per year basis. It should be noted that conversion costs might be a misnomer should there exist no conventional system analogous to the proposed data processing system; in which case, this cost component might be given the name 'developmental costs."

All other costs associated with the systems are defined to be operating costs. These costs include:

1. Data collection
2. Input (e.g. key punch)

3. Clerical support
4. Computer runs
5. User materials (i.e. records, forms, cards)
6. Labor and overhead in support offices as well as the D.P. office
7. Distribution
8. System maintenance
9. Hardware including Communication Lines
10, Software (e.g. lease costs, maintenance costs)

These costs must be estimated for the computerized system and also for the comparable conventional system, if such exists, normally on a per year basis. Having accomplished the cost analysis we can compute the relative cost as the difference between the costs of the "old" system and the "new" system with conversion costs distributed over some reasonable time period.

Certain costs, which we might identify as permanent costs, are likely to be incurred under both systems. In general, it is very unlikely that the computerized system would eliminate all clerical costs incurred under a system which is not computerized. In fact, a portion of these costs might remain unchanged under both systems.

The analysis of costs and preliminary system considerations may, in themselves, be a significant cost factor. This is especially true when a Database System is proposed. It is not unusual for the preliminary and feasibility studies to consume upwards of two man years of effort. Table I shows the costs that enter into a database undertaking. The preliminary costs are those encountered up to the time of installation. Continuing costs are those encountered after installation.

Processing Costs are a source of controversy in database systems, especially in institutions where the user is file oriented. Frequently an individual user will find that for specific applications, processing costs may increase significantly. At the University of Illinois, there were instances in which the CPU time doubled. The saving grace hopefully will be found in the benefits that are already realized from the system over a period of time.

III. ANALYSIS OF BENEFITS

Perhaps the most difficult area of cost/benefit analysis is a measurement of the benefits or returns associated with a new system. This is largely because of the subjectivity involved in estimating the quality of the new system and the value of improved performance characteristics. Here again we are concerned with the relative return associated with the new system versus that of the old system. Even when the proposed system will provide services that are currently not provided, the payoff must be assessed. An analysis of benefits would typically include the estimation of the value of:

1. Reduction of clerical and other resource expenditures
2. Additional information obtained
3. Quick turnaround and shorter lead times
4. Additional capability for research, instruction, administration
5. Interfacing with other systems
6. Indirect benefits

This type of analysis implies that information requirements and the capacity and flexibility of the system to satisfy such requirements be considered. Further, an evaluation must be accomplished relative to the availability of information and its effect on decision-making. For example, a model may assist in long range planning and budgeting. There would be little value attached to having information six days ealier through a computerized system unless a benefit is realized such as an improvement in decision-making, which results from more readily available information. If the information available through one system as compared to information from another system improves the quality, and perhaps the quantity of decisions, there should be a measure in the benefit analysis to reflect this. It is useful to estimate the penalty costs avoided by the new system. The avoidance of penalty costs should be included as benefits.

Cost/benefit analysis is often criticized because the relative returns are difficult to measure quantitatively. As long as the subjective nature of benefits is recognized and factored into the analysis, such criticism is unjustified. A cost/benefit analysis is, in fact, performed whenever a proposed system is evaluated, whether this is done formally on a systematic basis or informally as a global, intuitive judgment.

It is claimed that a systematic approach is much more likely to yield effective decisions in connection with new system developments. Certain costs and benefits can be readily quantified, others must be estimated, often on an intuitive basis. The proper approach should be to obtain as accurate a measure of the costs and benefit components detailed above as is possible.

IV. ANALYSIS OF DISBENEFITS

In performing an analysis relative to a new system it is incumbent on us to consider some of the disadvantages that accrue. These, I have called "DISBENEFITS". Frequently, the disbenefits can be sufficient to nullify all the benefits. More often than not, the questions raised in this approach lead to an alternate system which provide the advantages of the proposed system and eliminates objectionable features.

The analysis consists of creating a simple chart which reflects examining system and performance parameters from these aspects:

- Inviolate
- Accommodating
- Inconsequential

The inviolate category are those features that the system must satisfy. From the user's point of view these are generally performance features such as turnaround time or response time for on line systems, reliability, security, timeliness, or limitations imposed by finances, facilities, or ability to interface with existing resources. If a proposed system, hardware, software, cannot meet specifications in this category, it is not given further consideration.

The accomodating category refers to those features which would be nice to have; but which are not absolutely essential. This normally involves those parameters in which tradeoffs are possible within certain limits. Thus, for example, a specified maximum response time may be achievable. Faster response may be desirable, but not absolutely necessary.

Finally, the third category, inconsequential, includes those features which are nice to have provided they do not involve any excessive costs, or do not call upon special resources. For example, in considering a video display terminal, the capability to connect a printer may exist. However, the application for which the terminal is being purchased may have no requirement for hard copy.

Although the feature is not required, it would be nice to have for some unforeseen applications.

V. ELEMENTS OF COST AND BENEFITS

Table 2lists cost elements which typically occur in the pre-installation stage of data processing systems. Table 3 lists the cost elements which typically occur in operating the system. The costs must be accumulated for the present system and each of the proposed systems. While these tables provide useful guidelines they are not complete relative to a particular application. Table 4 lists intangible elements that affect a decision to adopt a new system. The importance of any of these may be the real basis for a decision.

Figure 2 is an example of the Benefit Analysis Form. The form is completed for each of the proposed systems. The operations costs include the cost of special software. In the hardware cost, it is possible to consider several configurations. However, each has an implicit affect on the other factors. The category of intangible provides management with the opportunity to include the affect of features in Table 4. The suggested procedure is to produce an average of the tangible item costs for each system. This cost need not be totaled in the dollar benefit. The category "other" is included as a catchall. For example, if rennovation affects the costs of lighting, heating, rent, etc. it would be reflected here.

In using the upper part of the form, the column $ Benefit/Month is the result of the difference between the present costs and costs of a new system. The sum of this column is the estimated cost benefit. Management controls the relative importance of each entry by weighing on a scale of 1 to 10 each parameter. The weighted value then provides a comparative benefit figure. In this analysis, specific items in the category "Intangible" could be called out and given specific weight. Thus, if hardware reliability, for example, were critical, its importance can be emphasized in the weight factor.

The lower part of the analysis sheet includes the one time costs. These are totalled to obtain a conversion cost which reflects the effect of the new system or equipment.

The return on investment can be viewed as a function of the payback period. A simple formula which employs the values calculated is shown at the bottom of the form.

VII. A DECISION FACTOR

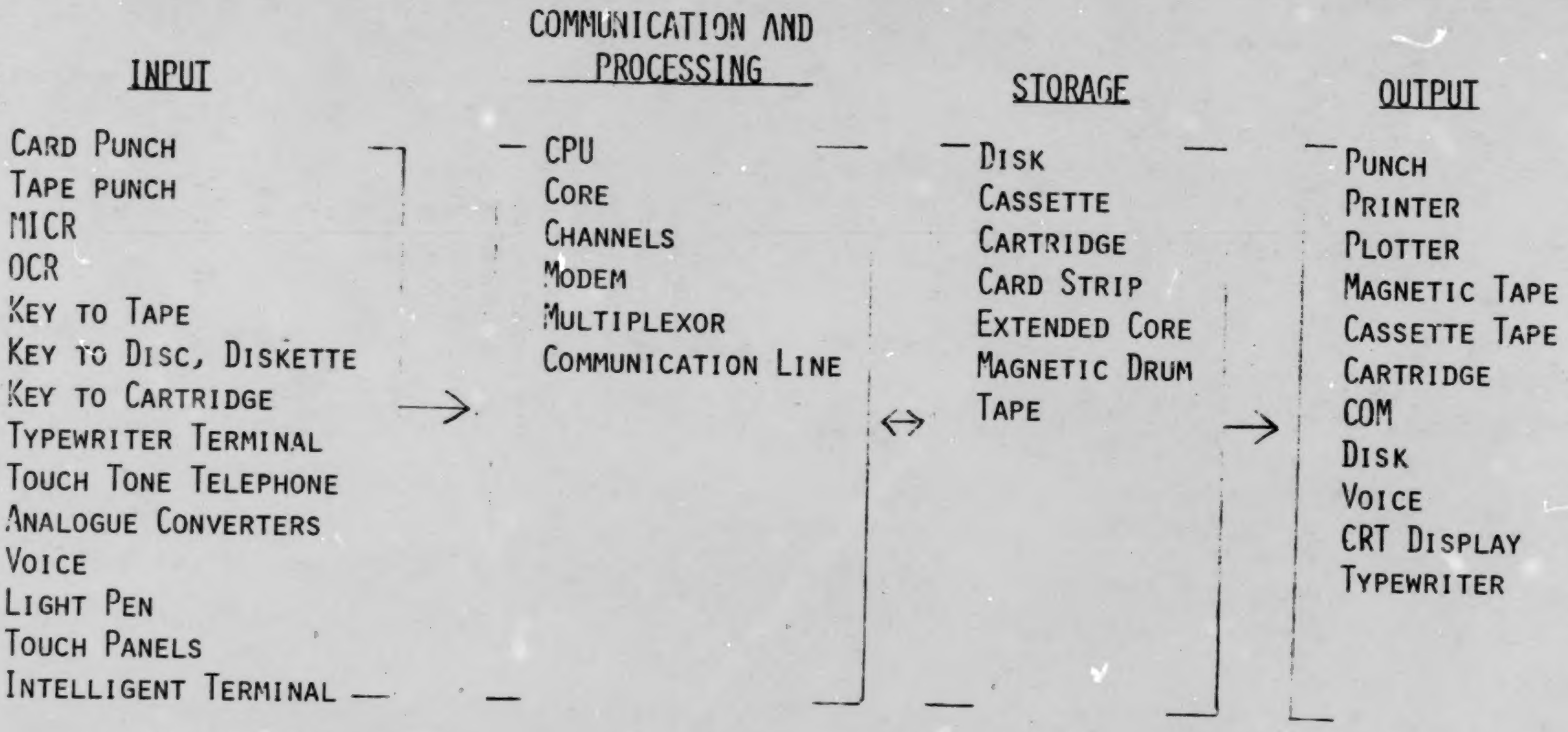
When examining benefits, the basic question of "Benefits for whom?" cannot be avoided. With the increased dependence on time sharing, multiprogramming, and data base, the addition of new applications, hardware, or software may not be directly accessable to a single user. An application may greatly benefit one user but degrade performance for another user. An economic analysis must be made from the point of view of the total university or agency rather than from the viewpoint of the individual user. The sum of benefits overall users must be considered in seeking an operational working level.

Computer centers must be especially aware of this tradeoff. The point for most efficient operation of the computer center may not be condusive to the development of new systems. On the other hand, the contribution of a new system to the total benefits may significantly override the inconveniences and added costs to the computer center. Management must be prepared to examine total impact and fund the computer operation accordingly.

VIII. CONCLUSION

Benefits analysis includes both tangible and intangible factors. It is possible to derive cost figures and arrive at a payoff function. The affect of intangible factors can be introduced into the analysis. The analysis provides a payoff function to differentiate proposed systems.

In public institutions we frequently are confronted with a triangle of decision makers who represent the data processing center, the user, and the institution's management. Benefit analysis is a tool which, when used properly, forces the group to consider many aspects and implications of a new system. It forces us to step back and evaluate the impact of a system on the total organization. The payoff and number associated with its calculation are indicators to be used with discretion. Although benefit analysis is not an end in itself, it is useful to clarify issues and improve the decision process.



INPUT

- CARD PUNCH
- TAPE PUNCH
- MICR
- OCR
- KEY TO TAPE
- KEY TO DISC, DISKETTE
- KEY TO CARTRIDGE
- TYPEWRITER TERMINAL
- TOUCH TONE TELEPHONE
- ANALOGUE CONVERTERS
- VOICE
- LIGHT PEN
- TOUCH PANELS
- INTELLIGENT TERMINAL

→

COMMUNICATION AND PROCESSING

- CPU
- CORE
- CHANNELS
- MODEM
- MULTIPLEXOR
- COMMUNICATION LINE

↔

STORAGE

- DISK
- CASSETTE
- CARTRIDGE
- CARD STRIP
- EXTENDED CORE
- MAGNETIC DRUM
- TAPE

→

OUTPUT

- PUNCH
- PRINTER
- PLOTTER
- MAGNETIC TAPE
- CASSETTE TAPE
- CARTRIDGE
- COM
- DISK
- VOICE
- CRT DISPLAY
- TYPEWRITER

HARDWARE
FIGURE 1

PRELIMINARY:

- Data base study
- Training (D.P. and uses)
- Hardware
- Communications
- Software
- Data capture
- Conversion (programs and data)
- Data base generation
- Computer utilization
- System design and development
- Testing
- Documentation
- Facility preparation
- Organization (i.e., D.B. Manager)
- Supplies

CONTRIBUTING:

- Personnel to manage
- Computer utilization
- Hardware maintenance
- Software maintenance
- Service programming
- Data maintenance
- Training
- Communications
- Storage
- Supplies
- Backup
- Security

Data Base Costs
Table 1

Feasibility Study	D. P. Analyst, User
Design & Development	D. P. Analyst, Programmer, User, Software*
Programming (Analysis/Coding)	D. P. Analyst, Programmer
Testing & Debugging	D. P. Analyst, Programmer, Key-punch (or other input), User, Forms, Materials, Computer**
Training	D. P. Analyst, User
Documentation	D. P. Analyst, Programmer, User, Storage Space
Facility Preparation	D. P. Personnel, User, Plant & Facilities
Overhead	Travel, Clerical, Reports, Miscellaneous

* Software costs include rental, installation, maintainance

** Computer costs include rental or purchase of peripherals, communication lines, tapes, etc.

PRE-INSTALLATION COSTS
Table 2

Item	Cost Generator
Data Preparation	User, D. P. Operations, Input personnel, Materials, Reader (e. g. UCR)
Processing	Computer time, Communication, Software
Associate Processing	Periphirals, Microfiche Process, Unit Record, Forms, Card, Chemicals, Materials, other
Output	Print Costs, distribution, bursting, Communications, Materials
Maintainance	D. P. Analyst, Programmer, User, Equipment
Documentation	D. P. Analyst, Programmer, User, Storage Space
Site Maintainance	D. P. Personnel, User, Facility Services
Training	D. P. Personnel, User
Overhead	Travel, Reports, Materials, etc.

OPERATING COST
Table 3

Timeliness: Receipt of information earlier -- faster turn-around from raw data to report-shortened lead times

Neatness: Information may be easier to obtain because of orderly layout

Innovation: Avoid reinventing the wheel due to ability to collect, maintain, and/or retrieve historical data

Flexibility: Ability to combine data from several, perhaps unrelated, sources. Increase the possible ways in which information can be reported and analyzed

Availability: Capability to provide information to an increased number of individuals (departments, etc.) -- Easy data access, display

Versitility: Equipment and systems are easily changed. Interface are easy, hardware is upward, compatable

Management: Improved accounting for funds, material, personnel, or other resources. Contributes to better planning decision-making. Yields better control over operations and organization

Reliability: Provides assurity that system will perform as expected

Communication: Improved communication and relations results between individuals, departments, etc. within or external to the organization, better reports

Prestige: Value obtained from a prestige standpoint within the organization, business, government and other educational institutions. Hardware and systems are state of art

Security: Ability to protect data from unauthorized exposure

Fear: Concern that individual's or office's status may be adversely affected through extra work or conversely, elimination of responsibilities, etc. (negative benefit)

INTANGIBLE BENEFITS

Table 4

COMPARATIVE BENEFIT ANALYSIS

	Present System	New System	$ Benefit/Month	Weight	Weighted Benefit
* Personnel					
* Operations (software)					
* Facilities					
* Supplies					
* Finance					
* Support					
* Hardware Cost					
* Intangible					
* Other					

Total Dollar Benefit: __________ Wgted Benefit: __________

One-Time Conversion Costs

Programming - New Application __________

Conversion __________

Operations - Procedures __________

Software __________

Duplicate Equipment for Test __________

Freight __________

Physical Installation - electrical, environment __________

TOTAL ESTIMATED CONVERSION COST __________

$$\text{Payback Period} = \text{Conversion Costs} \div \left(\frac{\text{Cost Benefit}}{\text{month}} - \frac{\text{Increased Hardware Cost}}{\text{month}}\right)$$

Figure 2

PANEL DISCUSSION:
ORGANIZATIONAL BENEFITS IN CONSOLIDATING INFORMATION SYSTEMS AND INSTITUTIONAL RESEARCH FUNCTIONS

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Information Systems
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Abstract

Several major institutions have consolidated their information systems and institutional research functions to report to a single administrator. The panelists in this session discussed their respective institutional experience with this organizational structure, emphasizing the reasons for the consolidation, the benefits, and the problems. Several of the attendees described similar activities they had been associated with.

The scope of the discussion covered the entire gamut of merging of the two functions to complete separateness. The concensus was that specialization of the two separate functions was necessary and a variety of organizational structures were available. There was some unanimity that it would be productive if the two units reported to the same organizational level.

INFORMATION SYSTEMS AND ACADEMIC DECISION MAKING: CONFLICT OR CONGRUENCE?

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Two dominant academic decision making belief systems are Collegial-Humanistic (C-H) and Technological-Analytic (T-A), the former person-centered and value referenced, the latter scientific, data based and information system dependent. Existing together in highly developed form they can produce organizational conflict of who decides what, when and how. Conflict resolution is basic to MIS diffusion into institutional decision making behavior. Prerequisite is documentation and description of this conflict. This study explicates the C-H and T-A constructs, and provides research evidence that high level conflict can exist between MIS administrators and different academic groups as to how decisions should be made.

INFORMATION SYSTEMS AND ACADEMIC DECISION MAKING: CONFLICT OR CONGRUENCE?

Academic administration is increasingly susceptible to technologies and procedures associated with scientific management due to the complex conditions currently confronting many institutions. Academic traditions and community consensus as standards and procedures for decision making are being supplemented with modern administrative processes which are much more rational in nature. Wheatley has made a study of a number of these management technologies and has found that many can be applied to the administration of colleges and universities. (2) They include management budgeting, simulation and gaming, and management information systems. He concludes that these tools and others like them provide some of the best methods yet devised for handling many present day administrative problems. (2:195)

While this may be true, their future use in institutions of higher education may be affected if the unique characteristics of these institutions are ignored and attempts not made to reconcile incompatible elements which may exist between the technologies and the academic process. In simplest form this potential incompatibility can be described as a difference between the importance of "things" and "people." (1:IX) It is the perceived difference that gave impetus for the present study of belief systems about academic decision making in one university setting between information system managers and various academic groups.

Background of Study

To study decision making beliefs of academic groups, it was first necessary to describe two belief systems extant in institutions of higher education. A third system that is essentially political was not included, for it was judged to be the product of situational requirements rather than a belief system regulating behavior across time. The following is a discussion of the two belief systems basic to this study.

Collegial-Humanistic

A collegial organization long has been recognized as the most appropriate model for academic people to make decisions. This almost universal recognition has directed the development of the modern institution of higher education. But because a collegial organization tends to be informal and consensus is used for arriving at decisions, certain basic requirements must be met for it to work effectively.

Without a highly formal structure the collegial organization requires stable reference points which are common to all members. These reference points, can be described as the purposes of the institution and they must be imbued with sufficient value to set guidelines to judge between alternatives in decision making. These reference points must have relevance for each and every organization member. Their stability is directly related to the stability of the institution.

A collegial organization also tends to be uncodified. The process for performing organizational tasks is not written but is learned through interaction with colleagues possessing the most experience and knowledge of the organization. Normative behavior, therefore, tends to be associated with senior members of the organization. In faculty affairs this is reflected in the importance of tenure and in the differentiation of academic personnel into ranks. There is seldom a written description distinguishing between ranks, but the difference nevertheless is understood.

Without a formalized structure and without written role descriptions, organizational continuity across generations is achieved through continual reinterpretation of the institution's past. Tradition, custom and sentiment play critical roles and are the basis for Founders' Days, homecomings and class reunions. By interpreting the past, a base is laid for preparing for the future. By this means organizational continuity is assured across time. But this process is appropriate only if the past is reliable for predicting the future. This, therefore, is the weakness of the traditional decision making process; the future must be related to the past. As many present-day problems have little or no historic counterpart, however, the past may become suspect as a directional guide for the future.

A collegial organization in ideal form probably has never existed in higher education. In reality its form has differed considerably over time and even between institutions. Nevertheless, the characteristics of the organization, which are defined here as the collegial-humanistic model, have always been viewed as supportive of the purposes of higher education. When equal parts of trust and reciprocity are added to these characteristics as the cohesive elements of the model, the process of decision making becomes well defined. The most distinguishing dimension of this process is that it places authority for decision making with those individuals who are most affected by them. The structural characteristics of the model are given in the following outline.

Collegial-Humanistic Decision Making Structure

STRUCTURE AND PURPOSE	Form - Institution --organized as single autonomous unit for, --purpose of organizational continuity Function - Process Oriented --person-centered organization for --achieving implicit academic goals
STANDARDS AND APPLICATION	Reference - Values --institutional values shared and mutually accepted by all members and, --these values also viewed as personal and subject to individual interpretation Behaviors - Implicit --mutual trust within membership and, --interdependence among members
AUTHORITY AND USAGE	Source - Professional Membership --authority over academic matters vested with professionals and dispersed according to, --seniority, rank, and experience of members Guidelines - Precedent --authority guides set by precedent interpreted through wisdom of members and, --traditions and ritual of institution

Technological-Analytic

It is increasingly obvious that the collegial-humanistic model is under extreme stress in the contemporary institution because of the many present-day problems which have little precedent. In many instances the model has been supplemented by other methods for deriving decisions, most notably those utilizing modern management techniques. These management tools have in common an analytical nature, a rational design and a requirement for application using logic.

The consequence has been a shift from value-based criteria for making decisions, as is accomplished by the collegial-humanistic model, toward a criterion of logic supported empirically by the analysis of objective data. This modern model which is defined here as technological-analytic tends to be product-centered rather than person-centered. It is not that the person is displaced in importance in this model, only that individual productivity can be seen as one factor in determining the cost and production efficiency of academic programs, a need created by diminishing financial resources and educational competition. In this situation decision making becomes increasingly dependent upon measurable data, and decision making authority gravitates to those who control the data and have the skills and knowledge to interpret them. The advantage derived for an institution from adding this new decision making process is an increased capability to respond to institutional problems and to plan more efficiently alternatives for an unsure future. The structural characteristics of the model are given in the following outline.

Technological-Analytic Decision Making Structure

STRUCTURE AND PURPOSE	*Form - System* --organized around flexible, interrelated units for, --purpose of maximizing organizational adaptability *Function - Output Oriented* --product-centered organization for --satisfying explicit educational needs
STANDARDS AND APPLICATION	*Reference - Criteria* --criteria rationally derived and, --applied using measurable data *Behaviors - Explicit* --objective interpretation of data for --rational choice among alternatives
AUTHORITY AND USAGE	*Source - Expertise and Function Within System* --authority placed with individuals and units according to, --information controlled and importance of system relationships *Guidelines - Accountability* --authority guides set by accountability interpreted through relevance of individuals' or units' function and, --overall effectiveness and efficiency of system

In its ideal form the *technological-analytic* model has many characteristics that sharply contrast with the *collegial-humanistic* model as, for example, its decreased emphasis on the past. Heavy emphasis is now placed upon the present. The past is seen as a handicap unless it is functional. Also, reliance upon trust and reciprocity declines in importance in the face of objective data which can describe all institutional conditions and processes.

As with the collegial-humanistic, the technological-analytic model also probably does not exist in ideal form. The condition prevalent in many institutions today is one of coexistence between some version of the two models. Where the two models overlap, there can be confusion and conflict. For this reason those responsible for introducing modern administrative technologies such as management information systems must be aware of this potential, otherwise their efforts may not be fully realized. This study was undertaken to understand better the elements of this issue.

The Study

The study proceeded from the premise that (1) there can be more than one belief system as to how academic decisions should be made; (2) the belief system held by information system managers may differ from other academic groups; and (3) this difference if existent can be measured quantitatively.

Instrument Development

To develop an instrument to assess both the collegial-humanistic (C-H) and technological-analytic (T-A) constructs, it was first necessary to review the literature relating to each. This literature was judged to include the academic fields of organizational and administrative theory, sociology, political science, public administration and educational administration. From the review, sets of items were developed for each construct. The items were then randomly ordered and given to a panel of five experienced judges to sort into piles representing each construct. Items not sorted correctly by four of the five judges were discarded. A seventy-item instrument was developed from the remaining items, thirty-five for each construct. The instrument was designed to be used with a five point Likert scale or as a Q sort. Both forms of the instrument were tested using different groups of professors, administrators and students.

Selection of Samples

As this was an exploratory study to test the difference in decision beliefs among academic groups and particularly between information system managers and these groups, it was felt the groups selected should reflect the normal population of academic institutions. Accordingly, groups of administrators, faculty and students were selected along with a group of information system managers. All groups were located at Indiana University-Bloomington except for a second faculty group from a church-related liberal arts college. This latter group was used as an external reference point to compare with the Indiana University groups as one means of testing the generalizability of the study's findings.

The information system manager group was comprised of thirteen persons, twelve males and one female. All had some academic training, with the large majority holding at least the bachelors degree. Their job titles included Operations Supervisor; Systems Assurance Group Manager; Data Base Administrator; Assistant Director, Systems Programs and Operations; Projects Manager, Systems Development; Lead Systems Analyst; and Director, Data Systems and Services.

The administrator group also had thirteen persons, most of whom held the doctorate. Although the majority were not responsible for administering academic programs directly, all were involved with major university programs dealing with faculty and student affairs. All had large staffs and budgets to administer. Job titles included Dean of Students, Dean of University Division (freshman and sophomore academic counseling), Director of University Housing, Director of Financial Aids, and Registrar.

The university faculty were all regular faculty members of the School of Education who were serving on the major implementation committees of the School at the time the study was conducted. There were nineteen in this group. All held the doctorate and represented the major program areas of the School.

The members of the University student group were all graduate students in the School of Education, and drawn from the same departments as the members of the faculty group. They were selected on the criterion that each aspired to be a college teacher upon degree completion. Nineteen persons comprised this group.

The liberal arts faculty group were representative of the academic program of the selected college. Most possessed the doctorate. Fourteen of the total faculty of twenty were used in the study.

Data Collection

Since the groups were relatively small in size, the Q-sort version of the instrument was employed. In this version each of the instrument items is printed on a separate card resulting in a deck of seventy cards. The cards are to be sorted into nine piles, ranging from pile #1 "Items most like your belief" to pile #9 "Items least like your belief." Each pile also specifies a limit to the number of cards which can be placed in it, e.g., pile #1 - three cards, pile #2 - five cards, . . ., pile #8 - five cards, pile #9 - three cards. This results in an approximation to the normal distribution of the cards across the nine piles. Item comparisons can be made between piles, and piles can be compared across groups. Each member of the five groups comprising the study was administered the Q-sort during the fall of 1975.

Two belief scores were generated by first identifying the item as either collegial-humanistic or technological-analytic and secondly, adding the weights [WEIGHT = 9 - (Pile number assigned to item) + 1] assigned to the items of each decision belief model. The item weights result in high scale scores for most strongly held beliefs and low scale scores for least strongly held beliefs.

Data Analysis and Discussion

Following from the premises of the study, hypotheses were generated regarding the differences between the information system manager group and the other four academic groups. These differences were examined by contrasting the means of the information system group to the other four groups on the collegial-humanistic and technological-analytic decision belief scales. The results of these contrasts are reported in Table 1.

TABLE 1. MEANS AND STANDARD DEVIATIONS OF THE DECISION BELIEF SCORES FOR ACADEMIC GROUPS

Academic Groups		Collegial Humanistic Score		Technological Analytic Score	
	N	$\bar{x}$	SD	$\bar{x}$	SD
Information System Managers	13	135.46[a]	9.07	214.54[b]	9.07
University Administrators	13	154.77	12.21	195.31	12.31
University Faculty	19	170.00	13.61	179.89	13.56
Liberal Arts College Faculty	14	172.86	16.45	177.21	16.44
University Graduate Students	19	157.79	12.06	192.58	12.05

[a] significantly ($p < .001$) lower than the other four means

[b] significantly ($p < .001$) higher than the other four means

It is evident from the information reported in Table 1 that the mean of the collegial-humanistic belief scale for the information system managers was substantially lower than the means for the other groups. Correspondingly the mean on the technological-analytic belief scale was substantially higher than the means for the other groups. These differences were found to be highly significant ($p < .001$) using multiple t-tests. Further, the differences were of sufficient magnitude that the reliability of the difference more than compensated for the pitfalls of using multiple t-tests and confounding the differences through the use of two scales that are ipsative in nature. That is, a very low ($p <$ .001) level of significance was found and the direction of the differences on the two scales was consistent with previously held expectations regarding the characteristics of the groups.

Looking at individual items, it was found that the item means for over one-half (54.3 percent) of the collegial-humanistic scale items were lowest for the information system manager group. This is a much higher percent than one would expect by chance alone (20 percent). Further, over two-thirds (68.6 percent) of the technological-analytic item means were rated highest by the information system manager.

TABLE 2. ACTUAL AND EXPECTED PERCENT OF ITEM MEANS FOR THE INFORMATION SYSTEM MANAGER GROUP IN CONTRAST TO THE OTHER ACADEMIC GROUPS

Information System Manager Group	Expected Per Cent of Items	Actual Per Cent of Items	
		CH	TA
Highest Group Mean	20	11.4	68.6
Lowest Group Mean	20	54.3	8.6
Neither Highest nor Lowest Group Mean	60	34.3	22.9

There seemed to be a reliable and consistent trend among the five groups for the information system managers to differ from the other academic groups in their decision making beliefs. This difference was evident in a predictable direction and was detected across a majority of the items. It was not merely a function of a very marked difference between groups on a few items but rather was found across the all major elements of the categories of the belief scales as displayed previously.

To highlight the differences, items were identified which significantly discriminated the information system manager group from the various other academic groups. The technological-analytic items are reported in Table 3 and the collegial-humanistic items are reported in Table 4. To identify these items, item means were contrasted among the five academic groups by using the Newman-Keuls (SNK) multiple comparison test and adopting the .05 level of significance. It was felt that this test provided a moderate level of power to detect differences yet prevented the risk of committing type one errors from approaching extremely high levels.

TABLE 3. TECHNOLOGICAL-ANALYTIC ITEMS FOR WHICH MEANS OF THE INFORMATION SYSTEM MANAGER (ISM) GROUP WERE SIGNIFICANTLY HIGHER THAN VARIOUS OTHER GROUPS

ISM group mean significantly higher than each of the other four group means (SNK, $p < .05$)

1. Academic decisions should be made by those who have professional training.
2. Administrators should be able to change the organization without faculty approval.
3. Academic decision making responsibility should rest with those individuals who have the skill to use objective data.
4. Academic decision making should rest principally with those who can apply objective criteria.
5. Those with decision making expertise should have primary decision making responsibility.

ISM group mean significantly higher than three of the other four group means (SNK, $p < .05$)

6. Individual faculty activity should reflect the goals of the administration.

ISM group mean significantly higher than two of the other four group means (SNK, $p < .05$)

7. Decision making should be centralized to ensure equity among academic units.
8. Empirically tested standards should be primary in academic decisions.
9. Objective data should be viewed as requirements for effective academic decisions.
10. Academic decisions should be located with those who have objective data.

TABLE 4. COLLEGIAL-HUMANISTIC ITEMS FOR WHICH MEANS OF THE INFORMATION SYSTEM MANAGER (ISM) GROUP WERE SIGNIFICANTLY LOWER THAN VARIOUS OTHER GROUPS

ISM group mean significantly lower than each of the other four group means (SNK, $p < .05$)

1. Individual worth should be paramount in an academic organization.
2. Academic decisions should be a shared responsibility.
3. Academic decisions should be based on the mutual trust of all people affected.
4. Entry into an academic organization should be determined only by its members.
5. Decision making responsibility in an academic community should rest with the membership.
6. Academic decisions should be made in an open manner based on shared values.
7. Academic decisions should be arrived at through consensus.
8. Academic decision making should be a shared process.

ISM group mean significantly lower than three of the other four group means (SNK, $p < .05$)

9. The locus of academic decision making should be as close as possible to those affected.
10. The administration's role should be to support faculty growth.

ISM group mean lower than two of the other four group means (SNK, p .05)

11. Academic decisions should be based on the mutual trust of all people affected.
12. Administrators should be academic people who share faculty values.

A sense of the elements constituting the decision making belief system of the information system managers is reflected in the key phrases of the items listed in Tables 3 and 4. In Table 3 are technological-analytic items where the information system managers group means were significantly higher (SNK, $p < .05$) than combinations of the other four groups. These constitute elements of the managers' decision making belief system in which they felt most strongly. Some of the key phrases in these items are "organizational change," "professional training," "expertise," "objective data," "empirically tested standards" and "centralization."

Table 4 presents those collegial-humanistic items where the information system managers group means were significantly lower (SNK, $p < .05$) than combinations of the other four groups. In this instance these items constitute elements of the managers' decision making belief system in which they felt least strongly. Here the key phrases are "individual worth," "community," decisions by "consensus," "trust," "shared values" and "shared responsibility."

The basic difference in the items presented in these two tables would seem to be that, compared to the other groups included in the study, the information system managers believe more in a scientific management decision making style where the academic and organizational environment can be measured rationally utilizing objective data, and that this environment is to be administered by only those who have proven decision making skills and expertise in administration. Concomitantly, in making decisions in this environment, of lesser importance are group values, trust and shared responsibility, all ingredients normally associated with an academic community.

In summary, based on this study, though limited in the number of groups tested and geographic locus, it can be concluded that a high level of disagreement can exist between information system managers and other institutional groups as to how academic decisions should be made. The degree to which this disagreement can effect information system infusion into institutional behavior and even disturb institutional equilibrium, however, cannot be answered without further study.

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HIGH BENEFIT SYSTEMS
AT LOW COST
FOR HIGH RANKING DECISION-MAKERS

Ronald Bleed
Director of Data Processing
Joliet Junior College

Joliet Junior College has a series of low cost systems that provide important decision-making information to key administrators of the college. Through a combination of systems, the College has maximized enrollment, with a minimization of course offering.

Key features include on-line student registration with telephone, computerized waiting lists, purging of unpaid students, displaying alternative sections when classes are closed or in conflict, billing students by mail, course cancellations by the computer, a system that tells when to hire additional instructors and a simulation system for five-year financial planning.

During the past decade there have been many problems in higher education that have effected most institutions. Perhaps the two most important have been enrollments and dollars.

Some colleges have faced declining enrollments and the dilemma of what to do about it, while others have faced rapidly increasing enrollments and the question of providing services and facilities to educate these new students.

Most colleges have faced the problem of limited dollars to run the school whether enrollment was going up or down. Inflation, employee salary demands, increased student financial aid programs and decreasing government revenues have caused much alarm to college administrators.

Many approaches have been used in an attempt to solve the financial crunch. MIS systems, modeling, program costing and unit costing have been some efforts with computers to solve these money problems. Joliet Junior College through some new computer programs has a new approach to the dollar problem.

Through a combination of systems, Joliet Junior College has maximized enrollments with a minimization of course offerings. This particular strategy provides for the quickest path to financial solvency. In fact, most of the decisions made from the information generated by these systems can be implemented immediately with dollar savings in the current semester.

Several separate programs and components make up these systems. Key features include: on line student registration with telephones; computerized waiting lists; purging unpaid students, displaying alternative sections when classes are closed or in conflict; daily enrollment in section reports; billing students by mail; course cancellations by the computer; a system that tells when to hire additional instructors and a simulation system for 5 year financial planning.

The online student registration with telephones has given the students a means of enrolling for classes with an ease that is not matched at most other colleges in the country. This ease has fostered enrollment growth particularly for the part time students.

To acquaint you with our system, let us go step by step through registration of a student. At Joliet Junior College, there are basically two kinds of students--the regular, full-time student and the part-time student. Joliet Junior College has an enrollment of 12,000 of which 3,000 are full time students. The full time students follow a slightly different path than part-time students.

Registration Path of Full Time Students

All full-time students are required to have an academic advisor. The student schedules an appointment with that advisor prior to the beginning of the semester. At this time, the advisor gives the student counseling information on what courses he should take. While looking over the course schedule in the advisor's office, the student selects, with the advisor's approval, the courses he wants. The advisor then registers the student by telephone.

In front of a terminal at the other end of the line, there is a terminal operator who answers the telephone call. The operator enters into the computer each of the course selections, verifying there is space available in that class, verifying there is no time conflict in the schedule, and that the student has the required labs and discussion groups for certain lecture courses. All this verification is being calculated and displayed automatically by the computer. At this same time, the student's demographic information is also displayed, so that the operator can then go through and verify the accuracy of the student's address, residency, race, sex, advisor, etc. Upon completion, the student is registered in his desired classes and receives his schedule through the mail. The student needs to do nothing further. The telephone call has taken approximately two minutes.

The demographic information on the student has been put into the system at the time the application is received. The student goes through the time-consuming process of providing name and address information only once.

While the student is registering for classes, several unique features of the system may be demonstrated. For example, if one of the classes is closed, or there are no seats available, the terminal operator can display all other courses of the same name and title that are not closed, and that do not conflict with courses the student has already signed up for, thus making the search for that difficult-to-find class much easier.

Another feature is to check for time conflicts. Previously, many students inadvertently scheduled classes at the same time. Now the computer automatically checks for that and does not allow them to do so unless specific override information is given.

Registration Path of a Part Time Student

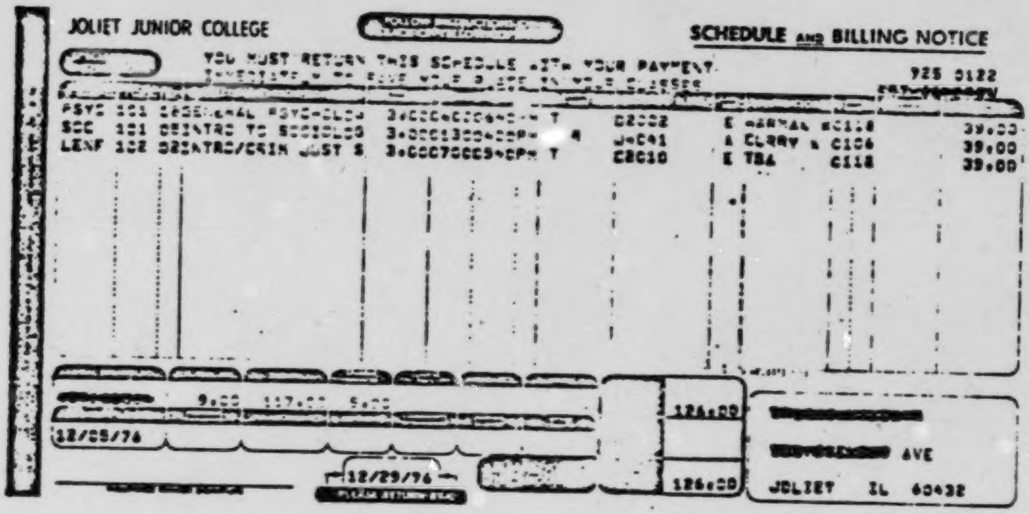
If the student is a part-time student, he need only call from his own home and request the course he wishes to take. The same telephone operator who took the information from a full-time student takes the call from the part-time student regardless of the kind of course.

Thus, Joliet has a system with 80,000 terminals. A student only has to pick up the phone and call the college to register. At some point later, he will be mailed a schedule with all his billing information. To be completely registered, he only needs to return that schedule by mail with payment enclosed. Of course, if a part-time student needs counseling, he is provided an advisor or counselor when he comes to campus.

Payment of Tuition and Fees

The college has carried the on-line registration system to the point of student receivables. Whether the student decides to return payment by mail, which is encouraged for all students, or decides to come and pay in person, his financial collection is done through a terminal verifying the exact amount of money that he owes the school. Financial aids, such as state scholarships, local loans, local scholarships, etc., are put into the system for that student prior to his payment. Thus, when he comes to pay in person, or by mail, he pays exactly what he's supposed to pay. The operator calls up the student's record on the terminal and enters into the terminal the amount of money being collected by check, by cash, or by certain types of financial aid. See Figure 1 for sample of schedule and billing notice.

SCHEDULE AND BILLING NOTICE



JOLIET JUNIOR COLLEGE

SCHEDULE AND BILLING NOTICE

YOU MUST RETURN THIS SCHEDULE WITH YOUR PAYMENT

725 0122

39.00

39.00

39.00

126.00

126.00

12/29/76

[redacted]

[redacted] AVE

JOLIET IL 60432

Figure 1

The time spent by most students ordinarily involves only a very few minutes in registration. They can call the college and register for their classes; a few days later they will receive their schedule and bill in the mail, write out a check, enclose it in a self-addressed envelope, and mail it back. There are no long lines to wait in, there is no need to come to campus: just to be there the first day of class.

This system is particularly useful at Joliet where we have many branch campuses located as much as 60 miles from the main campus. Thus, the convenience of registering by telephone rather than a long drive is very beneficial to the students. Because such a large portion of the college population is part-time, we believe that the ease of registration for part-time students has greatly increased the number of part-time students attending the college.

The telephone registration room is manned by employees who sit with a telephone and a computer CRT in front of them. All telephone registration personnel are part-time employees, a fact which keeps costs at a minimum. Peak registration periods require eight employees, but during other times, the number can be reduced to one or two. This registration system is open from 8:00 in the morning till 9:00 in the evening every day that the school is open. The college has been adopting a much more flexible scheduling policy. Classes start and stop at many times during the year. With advance registration beginning very early, the registration process never ends. It is continuously on-line. Continuous on-line registration is possible because the system can support the other on-line systems such as accounting, payroll, inventory, financial aids at the very same time registration is going on.

The President of the American Association of Community and Junior Colleges, Dr. Edmund J. Gleazer, was impressed with the registration system. He commented, "One of the things that impressed me most on my visit to Joliet was its easy-access registration process. Through a sophisticated computerized system, Joliet makes it possible for people to enroll quickly and painlessly by telephone. The tedious waiting and floundering that has been so long associated with registration is thus eliminated."

Purging

Besides ease of registration to promote enrollment growth, making available courses students want is also crucial. The purging of unpaid students from classes opens up seats in choice courses for new students to enroll. In order to purge students, the computer must bill students prior to the start of the semester with specified dates for payment. The collection of the tuition payments must be on-line with the ability to update immediately the paid status of each student's courses. Any student not paying by his deadline date is dropped from the course. By eliminating the "no show" students, enrollments may be maximized within each section. At Joliet Junior College, a strong teachers union contract and physical room size limitations make it necessary to enroll up to the class limit but not to exceed the limit. The less seats reserved for non payment students, the greater the efficiency in course offerings. Purging may be done selectively or automatically.

Waiting List

In addition, a waiting list system is kept in an on-line mode on the computer. When a student registers and there are no seats available in one of the courses he has requested, the student may be placed on the waiting list for that course. After a student is purged or dropped, the first student on the waiting list is called and offered that available seat.

Savings

These efficiencies can be translated into actual dollars saved. In comparing day enrollments in the Fall of 1976 to the Fall of 1977, 5% more students enrolled, but the number of sections offered decreased by 5%. This is a 10% savings, that, to a large part, can be attributed to computerized processes. Based upon the college's unit cost the dollars saved amounted to $137,503. The average income per credit hour times the additional hours contributes an added $60,093. Thus the total dollars adds to $197,596.

Costs and Staff

The on-line computer system is a Four-Phase mini-computer with 96K memory, 200 million byte disk capacity, 1 printer, 1 mag tape and 19 CRT's. This system supports the administrative functions of the college. The hardware and the bulk of the software were purchased for under $200,000. On a 5 year payback with maintenance costs added, the rate per month for hardware and software is $4200.

Using a formula based on number of students in a college divided by the hardware cost per month, Joliet has the most cost effective ratio in the state of Illinois. This cost is .59 per student per month. In fact, other Chicago suburban area junior colleges average 3 times the cost per student as does Joliet.

The number of the data processing personnel is small. The staff consists of 1 director, 1 programmer, 2 operators and 1 keypuncher.

Course Cancellations

Besides the on-line development, several systems have been designed in a batch format. Reports describing when to cancel courses, when to add staff and how to simulate 5 year plans have proven very useful to the administration of the college. These systems are written in COBOL for a small computer. The costs to implement are minimal with no additional hardware required.

To minimize the number of course offerings a computerized system was developed that indicated which classes should be cancelled because of insufficient enrollment. Built into this system were the key concepts of "budgeted income" and "breakeven".

In budgeting at Joliet, each satellite center (extension center) is a cost center. Each center is expected to generate a certain amount of income. New and developing centers may be budgeted at a loss, while large, established centers have a predetermined level of profit. With each satellite, there are fixed costs regardless of the number of course offerings and there are variable costs that increase with the number of courses. Fixed costs include building leases, and the budgeted "profit". Variable costs include instructor salary.

When a course is cancelled, the variable costs are eliminated but the fixed costs must be absorbed by the remaining courses. Conceptually, it is possible to cancel too many classes. There is an optimum point in which to maximize your profits or minimize your losses because of the built in fixed costs. The computer calculates that point and prints out what courses to cancel and in what sequence.

"Breakeven" analysis is also done for the satellite. In this calculation the "budgeted profit" for the satellite is not considered. The computer calculates which courses should be cancelled and in what sequence so that incoming dollars for that satellite match the outgoing dollars.

The power of the computer permits reiterations of cancelling courses then testing for the breakeven point or budgeted profit point. The computer starts with the worst case of a money losing course and then cancels that course. A test is made for the optimum and breakeven points. If neither has happened, the computer cancels the next worse course and tests. This cycle keeps repeating until those points have been calculated. Then a report lists all courses for that satellite with complete details on enrollments, incomes and costs and a code describing what type of action to take on that course. Summary figures are also generated for that satellite. See Figure 2 for a sample report.

This system does not automatically cancel the courses on the computer disk records. Subjective judgments still can be used. For example, if a class is needed for graduation by some students, that class may be offered even though the computer says to cancel it. Conversely, just because a satellite has some large enrollment courses that cause no computer cancellation messages to appear, it does not mean that low enrollment courses still should be run.

The old way of cancelling classes at Joliet simply involved using some "magic number" such as 12 as the cutoff point. Any class less than that was killed. As proven by the new system, the old way actually cost the college some money. Under the new way, the Vice-President and his three Academic Deans meet daily at 8:00 a.m. to review the course cancellation report and determine what courses to keep, to cancel, or to watch closely.

Adding Staff

Another system has been developed at Joliet to improve decision making. This system is useful in predicting when to add more instructors to a department and the cost for the additional staff.

During the middle of the year the budgets are built for the following year. At this time enrollment predictions are made and requests come from some departments for additional teachers. Because salaries make up 80% of a school's budget, great care must be taken in evaluating these requests. Also at Joliet, the rate of pay for a part-time instructor or the overload (extra pay) assignment of a full-time instructor is 1/3 the rate of hiring a new full-time person.

COURSE CANCELLATION DETAIL

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DATE 08/19/77                                  JOLIET JUNIOR COLLEGE                                              PAGE  20

                                         COURSE CANCELLATION REPORT    FALL 1977

                 SEM  CON  TCHR  STATE                  CR            CONTRACT   TOTAL    ((( -- BREAKEVEN )))     (( -- MEET BUDGET ))      DROP
SECTION          HRS  HRS  TYPE  RATE    TUIT ENR      HRS    INCOME    COST      COST    DOLLARS  CR HRS  ENR     DOLLARS  CR HRS  ENR       CODE
SATELLITE: LINCOLNWAY                    TYPE: STATE RATES 1-8

ACCY 101 18 0 3.0   3.0 PRT   14.49 13.00  21   63.0   1731.87  675.00    731.51   1000.36   36.4   12      509.33   18.4    6        0
BLAW 101 09 0 3.0   3.0 PRT   14.49 13.00  15   45.0   1237.05  675.00    731.51    505.54   18.4    6       10.57    0.4    0        0
ENG  101 44 8 3.0   3.0 PRT   21.24 13.00   8   24.0    821.76  675.00    731.51     90.25    2.6    1      404.72-  11.8-   4-       0
ENG  102 15 8 3.0   3.0 PRT   21.24 13.00   8   24.0    821.76  675.00    731.51     90.25    2.6    1      404.72-  11.8-   4-       0
ENG  208 01 8 3.0   3.0 F16   21.24 13.00   2    6.0    205.44  633.45    650.36    444.92-  20.0-   7-    1179.89-  34.5-  12-       0
MATH 131 10 8 4.0   3.0 PRT   21.24 13.00   5   20.0    684.80  900.00    958.68    273.68-   8.0-   2-     933.84-  27.3-   7-    2MAX
MATH 135 04 E 3.0   3.0 PRT   21.24 13.00   4   12.0    410.88  675.00    731.51    370.63-   9.4-   3-     815.60-  23.8-   8-    5MAX
PSCI 101 07 8 3.0   3.0 F16   21.24 13.00   4   12.0    410.88  833.83    850.36    475.48-  14.0-   5-     974.42-  28.5-  10-    4MAX
PSYC 101 23 C 3.0   3.0 PRT   21.24 13.00  19   57.0   1951.68  675.00    731.51   1220.17   35.6   12      725.20   21.9    7     3MAX
PSYC 205 07 C 3.0   3.0 PRT   21.24 13.00   9   27.0    924.48  675.00    731.51    192.97    8.6    2      302.CC-   8.8-   3-       0
PSYC 210 05 0 3.0   3.0 PRT   21.24 13.00  17   51.0   1746.26  675.00    731.51   1014.73   29.6   10      513.76   15.9    5        0
REAL 101 05 0 3.0   3.0 PRT   14.49 13.00   7   21.0    577.29  675.00    731.51    154.22-   5.6-   2-     649.19-  23.6-   8-       0
SMRT 101 05 0 3.0   4.0 PRT   14.49 13.00   2    6.0    164.94  883.00    941.51    776.57-  28.2-   9-    1271.54-  46.3-  15-    6MAX
SOC  101 10 6 3.0   3.0 TDA   21.24 13.00  10   30.0   1027.20  675.00    731.51    293.43    8.6    3      199.28-   6.8-   2-    1MAX
SPCH 101 22 8 3.0   3.0 PRT   21.24 13.00  16   48.0   1643.52  675.00    731.51    912.01   26.4    9      417.04   12.2    4        0
```

COURSE CANCELLATION TOTALS

```
        DATE 08/19/77                               JOLIET JUNIOR COLLEGE                                     PAGE  23

                                              COURSE CANCELLATION REPORT    FALL 1977

ECTS  SEM HRS  ENR    CR HRS     INCOME     TOT COST  AVG INC  AVG ENR   $ --      CR HRS --   $ --        CR HRS --   ENR --   ENR/SECT
                                                       /CR HR   /SECT   BRK-EVEN  BRK-EVEN    BUDGET       BUDGET      BUDGET   -- BUDG.
ATELLITE: LINCOLNWAY             TYPE: RATES 1-5 AS IS
 15     46.0   147    446.0     14359.73   11727.70   32.20    9.8     2632.09     81.7     4957.40-     154.0-      50.7-     3.4-
ATELLITE: LINCOLNWAY             TYPE: RATES 1-5 BREAK-EVEN
 15     46.0   147    446.0     14359.73   11727.70   32.20    9.8     2632.09     81.7     4957.40-     154.0-      50.7-     3.4-
ATELLITE: LINCOLNWAY             TYPE: RATES 1-5 MAX PROFIT
  9     27.0   123    369.0     11905.86    4425.00   32.26   13.7     5280.56    163.7     2308.93-      71.6-      23.9-     2.7-


ATELLITE: LINCOLNWAY             TYPE: RATES 6-8 AS IS
  7      9.5    19     32.0       729.83    2704.19   22.41    2.7     1974.26-    56.6-    1976.26-      56.6-      81.4-     7.3-
ATELLITE: LINCOLNWAY             TYPE: RATES 6-8 BREAK-EVEN
  0      0.0     0      0.0         0.00       0.00    0.00    0.0        0.00      0.0        0.00        0.0        0.0      0.0
ATELLITE: LINCOLNWAY             TYPE: RATES 6-8 MAX PROFIT
  0      0.0     0      0.0         0.00       0.00    0.00    0.0        0.00      0.0        0.00        0.0        0.0      0.0


ATELLITE: LINCOLNWAY             TYPE: RATES 1-8 AS IS
 22     55.5   166    478.0     15089.72   14433.89   31.57    7.5      655.83     20.8     6933.66-     219.6-      76.3-     3.5-
ATELLITE: LINCOLNWAY             TYPE: RATES 1-8 BREAK-EVEN
 15     46.0   147    446.0     14359.73   11727.70   32.20    9.8     2632.09     81.7     4957.40-     154.0-      50.7-     3.4-
ATELLITE: LINCOLNWAY             TYPE: RATES 1-8 MAX PROFIT
  9     27.0   123    369.0     11905.86    4425.00   32.26   13.7     5280.56    163.7     2308.93-      71.6-      23.9-     2.7-
```

Figure 2

The new system prints a report with an analysis for five years following a base year. Predictions are made in each course and department for student credit hours, number of sections, student capacity, overload hours to be used, number of full-time instructors to be hired and total staff costs.

To drive the system, certain inputs must be gathered. For the entire college, some of the factors include: maximum regular hours for a full-time teacher, average semester cost of a full-time teacher, average semester cost of a part-time teacher, average cost of an overload semester hour, average cost of hours taught off campus. Each of these factors must also be given a percentage increase for each of the 5 years.

For individual departments, some of the factors include: the number of full-time teachers, the number of the overload hours used, the maximum number of overload hours possible, the overload maximum for one teacher and 10 growth factors for the fall and spring semesters for the next 5 years.

The basic idea behind the system is that capacity credit hours for a course (size limit times the credit hours) must always equal or exceed enrollment credit hours for the course (student actually enrolled times credit hours).

Because of room limitations, teacher union contracts or educational reasons each course has a specified enrollment limit that cannot be exceeded. The goal of Joliet is to maximize enrollments within these limits. Only when enrollments exceed capacity will sections be added.

The sections of each course are processed in turn. (A course is a set of one or more sections of the same course name.) The growth factors are multiplied by the base year figures to predict course enrollment credit hours for each of five years. Enrollment credit hours are then compared with capacity credit hours, year by year, and sections are added when needed. Each section added one year is maintained in all following years.

If a new section is added to an on campus day fall course, it is taught on an overload basis if possible. But if insufficient overload hours are available in the section's department, a new teacher is hired to take the new section and relieve other teachers of at least some of their overloads. A teacher hired in one year is retained in all following years.

If a new section is added to an on campus day spring course, it is automatically handled on an overload basis, because teachers are not hired in the spring.

Costs for on campus day fall and spring are determined by the number of teachers and overloads. For all other courses, the costs are determined by semester hours taught and the average cost per semester hour. Sections with more contact hours than semester hours have additional costs included. All totals are maintained as sections are added.

INDIVIDUAL COURSE PREDICTION

```
DATE 02/18/77
                                         JOLIET JUNIOR COLLEGE
                          PREDICTION OF FACULTY COST FOR 5 YEARS FOLLOWING 76-77                         PAGE
      DEPT: AGRICULTURE
                                             DATL: ON-CAMPUS DAY
                                                                         SEM: FALL
                                 % OVER/   CURR ENR  ENR CR HRS  *  GROWTH
                    SEM    CURR   CURR  UNDER(-)   MINUS      MINUS    *  FACTOR               PRED ENR                PRED ENR CR HRS
COURSE     SEC      HRS    CAP    ENR     CAP    CURR CAP  CAP CR HRS  *  77-78    PRED   ENR    MINUS    PRED ENR        MINUS
AGRI 231   03      3.00     18     16    11.1-      2-        6.00-    *  1.0288   ENR    CHNG  CURR CAP  CR HRS   CURR CAP CR HRS
AGRI 231   08      3.00     18     18      .0       0          .00     *  1.0288   16.5    .5    1.5-     49.50        4.50-
 TOTALS            6.00     36     34     5.6-      2-        6.00-    *  1.0288   18.5    .5     .5      55.50        1.50
5-YR CASE PREDICTION                                                               35.0   1.0    1.0-    105.00        3.00-
                  YEAR   GRTH FCTR   SEM HRS   STU CAP     (A)          (B)      % EFFCY   SECTIONS
                  77-78    1.0288      6.00       36    CAP CR HRS  ENR CR HRS   (B/A)    NEW TOTL
                  78-79    1.0288      9.00       54      108.00      105.00      97.2          2
                  79-80    1.0288      9.00       54      162.00      108.02      66.7      1   3
                  80-81    1.0288      9.00       54      162.00      111.13      68.6          3
                  81-82    1.0288      9.00       54      162.00      114.33      70.6          3
                                                          162.00      117.62      72.6          3
                                                                                                3
```

DEPARTMENT PREDICTION

```
DEPT PREDICTIONS FOR                                             (A)           (B)      % EFFCY   SECTIONS      SEM-HR OVERLOADS           FT-TCHRS
DATL AND SEM ABOVE   YEAR   GRTH FCTR   SEM HRS   STU CAP    CAP CR HRS    ENR CR HRS    (B/A)   NEW TOTL   ALLWD    IN USE   SHORT    NEW TOTL
                     76-77                184.00    1,403     4,536.00      3,370.00      74.3         57    55.00    30.00              11.5
                     77-78    1.0288      187.00    1,440     4,647.00      3,466.23      74.6     1   58    55.00    33.00              11.5
                     78-79    1.0288      203.00    1,567     5,033.00      3,566.04      70.9     5   63    55.00    49.00              11.5
                     79-80    1.0288      207.00    1,596     5,169.00      3,668.77      71.0     1   64    55.00    53.00              11.5
                     80-81    1.0288      218.00    1,714     5,486.00      3,774.42      68.8     4   68    60.00    67.00            1 12.5
                     81-82    1.0288      228.00    1,774     5,692.00      3,883.11      68.2     2   70    65.00    81.00            1 13.5
```

COLLEGE PREDICTION

```
         FULL-TIME    OVERLOAD     SEM HRS     SECTIONS OF     TOTAL      STUDENT         (A)             (B)          % EFFCY
         TEACHERS     HRS USED     TAUGHT      CON > SEM HRS   SECTIONS   CAPACITY    CAP CR HRS      ENR CR HRS       (B/A)
76-77      128.0       392.50     9,239.50        1,656         3,443     123,806     327,371.50      142,228.00        43.4
77-78      128.0       448.50     9,502.00        1,654         3,507     124,384     331,805.00      146,207.80        44.1
78-79      128.0       531.00     9,649.00        1,704         3,557     125,498     335,159.50      150,441.67        44.9
79-80      128.0       590.00     9,753.50        1,719         3,593     126,601     338,470.50      154,738.19        45.7
80-81      131.0       655.50     9,923.50        1,742         3,650     128,148     343,197.50      159,098.36        46.4
81-82      133.0       713.00    10,043.00        1,755         3,689     129,254     346,693.50      163,527.04        47.2


           TOTAL        FULL-TIME TEACHER    OVERLOAD HOUR      SEM HR        CON HRS > SEM HRS
           COST               COST               COST            COST               COST
76-77   $3,995,766         $2,048,000          $84,780        $1,515,406          $347,760
77-78   $4,260,093         $2,170,880         $113,022        $1,614,128          $362,060
78-79   $4,432,080         $2,279,424         $133,812        $1,652,484          $366,360
79-80   $4,694,935         $2,416,128         $156,350        $1,744,272          $378,180
80-81   $4,939,388         $2,596,420         $173,708        $1,786,020          $383,280
81-82   $5,265,238         $2,794,330         $198,224        $1,877,833          $394,875
```

Figure 3

COST PREDICTIONS

```
DATE 02/18/77

                                         JOLIET JUNIOR COLLEGE
                         PREDICTION OF FACULTY COST FOR 5 YEARS FOLLOWING 76-77                              PAGE  763

                                       SATELLITE-SEMESTER TOTALS
                     AVGCST   (1) FT-TCHR  OVERLOAD    AVGCST (2) OVRL   TOTAL             TOTAL                 (3)          (4)        % EFFCY
        FT-TCHRS X   /SEM =      COST      SEM HRS X   /HR  = HR COST    (1+2)   SEM HRS   SECTS  STU CAP  CAP CR HRS   ENR CR HRS    (4/3)
SATL:  ON-CAMPUS DAY         SEM:  FALL
76-77     128.00     8000      1024000      200.50     240     48120    1072120   1901     626    20376    60266.50     35724.00     59.3
77-78     128.00     8480      1085440      216.50     252     54558    1139998   1917     632    20442    60437.50     36746.50     60.8
78-79     128.00     8904      1139712      252.50     252     63630    1203342   1953     645    20735    61318.50     37830.80     61.7
79-80     128.00     9438      1208064      262.50     265     69563    1277627   1963     648    20866    61734.50     38293.08     63.0
80-81     131.00     9910      1298210      265.50     265     70358    1368568   2011     663    21370    63351.50     40013.66     62.2
81-82     133.00    10505      1397165      270.50     278     75199    1472364   2046     673    21651    64267.50     41146.99     64.1
SATL:  ON-CAMPUS DAY         SEM:  SPRING
76-77     128.00     8000      1024000      152.00     240     36480    1060480   1867     610    18180    54720.00     36799.50     67.2
77-78     128.00     8480      1085440      232.00     252     58464    1143904   1947     630    18700    56683.50     37854.25     66.8
78-79     128.00     8904      1139712      278.50     252     70182    1209894   1993     645    19072    57779.00     38944.08     67.4
79-80     128.00     9438      1208064      327.50     265     86788    1294852   2042     662    19615    59399.00     40086.05     67.5
80-81     131.00     9910      1298210      390.00     265    103350    1401560   2105     680    20023    60864.00     41222.00     67.7
81-82     133.00    10505      1397165      442.50     278    123015    1520180   2157     695    20474    62563.00     42407.18     67.8
SATL:  ON-CAMPUS DAY         SEM:  FALL AND SPRING
76-77     128.00    16000      2048000      352.50     240     84600    2132600   3768    1236    38556   114987.00     72523.50     63.1
77-78     128.00    16960      2170880      448.50     252    113022    2283902   3864    1262    39142   117121.00     74600.75     63.7
78-79     128.00    17808      2279424      531.00     252    133812    2413236   3946    1290    39807   119097.50     76749.28     64.4
79-80     128.00    18876      2416128      590.00     265    156350    2572478   4005    1310    40479   121133.50     78959.67     65.2
80-81     131.00    19820      2596420      655.50     265    173708    2770128   4116    1343    41393   124215.50     81233.66     65.4
81-82     133.00    21010      2794330      713.00     278    198214    2992544   4203    1368    42125   126830.50     83573.14     65.9
                     AVGCST   (1) SEM HR   CON HRS)    COST/   (2) CON   TOTAL
        SEM HRS X    /HR =       COST      SEM HRS X SECTN = HR COST     (1+2)             TOTAL                 (3)          (4)        % EFFCY
                                                                                           SECTS  STU CAP  CAP CR HRS   ENR CR HRS    (4/3)
SATL:  ON-CAMPUS EVENING     SEM:  FALL
76-77    1019.50      240       244680      417.00     210     87570     332250            437    12207    30395.50     11815.00     38.9
77-78    1030.50      252       259686      421.00     215     90515     350201            441    12257    30539.50     12179.25     39.9
78-79    1041.50      252       262458      424.00     215     91160     353618            445    12389    30878.50     12534.82     40.6
79-80    1051.50      265       278648      427.00     220     93940     372588            448    12468    31171.50     12889.56     41.4
80-81    1061.50      265       281298      432.00     220     95040     376338            453    12593    31415.50     13245.26     42.2
81-82    1067.50      278       296765      434.00     225     97650     394415            455    12639    31562.50     13600.16     43.1
SATL:  ON-CAMPUS EVENING     SEM:  SPRING
76-77     822.50      240       197400      268.00     210     56280     253680            283     9246    26705.50     14581.50     54.5
77-78     869.00      252       218988      283.00     215     60845     279833            299     9662    27913.00     15012.30     53.8
78-79     901.00      252       227052      292.00     215     62780     289832            309     9866    28600.00     15450.70     54.0
79-80     919.50      265       243668      299.00     220     65780     309448            316    10043    29087.00     15887.95     54.6
80-81     952.50      265       252413      310.00     220     68200     320613            327    10309    29905.00     16326.42     54.6
81-82     966.50      278       268687      314.00     225     70650     339337            332    10437    30271.00     16763.98     55.4
```

Figure 4

The output reports (predicted enrollments and costs) from this system can have complete details printed or just summary information. The reports are printed by department. See Figures 3 and 4 for a sample report.

This system has proven very useful in limiting the hiring of new full-time staff. For a department chairman to add staff without computer justification requires that a strong case be made for the new staff member. Last year at JJC the original requests for new staff totaled 17. Only one new position was added and enrollment grew 5%. No significant discomfort was felt by staff or students because of limiting new staff.

Plansim

The college has developed another system to assist top ranking administrators. To build the budget, to analyze labor proposals, and to make long range financial plans, a simulation system named PLANSIM has been programmed.

The primary purpose of PLANSIM is to simulate these planning decisions in advance with an experimental environment rather than in a real life situation. Being able to select the best alternative can save costs in the form of human and material resources. In critical situations, the selection of the best alternative may also be what keeps the institution alive. In this era of rising costs, limited resources, and uncertain growth rates, the importance of selecting the best alternative is a key to success of any organization.

A computer model is constructed according to predetermined rules, parameters and the simulation language called PLANSIM. Less than 20 instructions are in the language called PLANSIM. From this repertoire of instructions, either a small model may be built or a very large model with thousands of variables. Complexity is created only through the use of simple instructions many times.

The ability to test alternatives by recycling is a great advantage of this system. Often this recycling means changing only a very few factors. The evaluation of the steps in model building provide insight to the planning and decision making process.

In building a JJC 5 year plan, each planning item or variable was first defined and then projected or interrelated with other variables. Input to build the 5 year model is through punched cards. The header card establishes the title or identification of the model. Planning item cards follow and define all items to be used in building the model. For example, these cards define all anticipated income such as tax revenues, state apportionment sources, tuition and fees; and expenses such as salaries, contractual services, utilities, supplies and travel.

The third set of cards provide the instructions to be performed upon the planning items. Calculations may be done for any or all of the 5 years. After all the instructions have been performed, the planning items are printed with the results of the calculations. Planning items may be printed in any sequence and any number of times. See Figures 5 and 6 for a sample report.

PLANNING VARIABLES

```
     DATA DEFINITIONS                          JOLIET JUNIOR COLLEGE                    10/26/77
   PROGRAM NAME = JOLIET JC 5 YEAR PLAN
                                                                              AUTHOR = JJC ADMINISTRATION
ITEM NUMBER =  1        DESCRIPTION = ** ESTIMATED REVENUE      BASE VALUE =          0.00
ITEM NUMBER =  3        DESCRIPTION = ** LOCAL GOVERNMENT       BASE VALUE =          0.00
ITEM NUMBER =  4        DESCRIPTION = ASSESSED VALUATION        BASE VALUE.=          0.00
ITEM NUMBER =  5        DESCRIPTION = TAX RATE                  BASE VALUE =      1,250.00
ITEM NUMBER =  6        DESCRIPTION = CHARGE BACK REVENUE       BASE VALUE =          0.00
ITEM NUMBER =  7        DESCRIPTION = TOTAL LOCAL GOVNMENT      BASE VALUE =          0.00
ITEM NUMBER =  8        DESCRIPTION = LOCAL TAXES               BASE VALUE =          0.00
ITEM NUMBER =  9        DESCRIPTION = BACK TAXES                BASE VALUE =      7,500.00
ITEM NUMBER = 10        DESCRIPTION = STATE APPORTIONMENT       BASE VALUE =          0.00
ITEM NUMBER = 14        DESCRIPTION = PLACEMENT GRANT           BASE VALUE =          0.00
ITEM NUMBER = 21        DESCRIPTION = TOTAL DVTE                BASE VALUE =    130,284.00
ITEM NUMBER = 22        DESCRIPTION = TOTAL STATE GOVNMENT      BASE VALUE =          0.00
ITEM NUMBER = 23        DESCRIPTION = STATE WORK STUDY-ETC      BASE VALUE =     13,836.00
ITEM NUMBER = 30        DESCRIPTION = ** TUITION AND FEES       BASE VALUE =          0.00
ITEM NUMBER = 31        DESCRIPTION = TUITION RATE              BASE VALUE =         10.00
ITEM NUMBER = 32        DESCRIPTION = FEES                      BASE VALUE =     31,000.00
ITEM NUMBER = 33        DESCRIPTION = TOTAL TUITION             BASE VALUE =          0.00
ITEM NUMBER = 35        DESCRIPTION = TOTAL TUITION + FEES      BASE VALUE =          0.00
ITEM NUMBER = 37        DESCRIPTION = OTHER INCOME              BASE VALUE =    103,481.00
ITEM NUMBER = 36        DESCRIPTION = ** OTHER INCOME           BASE VALUE =          0.00
```

INSTRUCTIONS

```
         INSTRUCTIONS                               JOLIET JUNIOR COLLEGE                     10/26/77                PAGE 5
INCREASE     TOTAL TUITION HOURS   (058) BY       003. PERCENT                                                        FROM 02 THRU 05
INSERT IN    TUITION RATE          (031)            10.00                                                             FROM 01 THRU 01
INSERT IN    TUITION RATE          (031)            15.00                                                             FROM 02 THRU 05
MULTIPLY     TOTAL TUITION HOURS   (058) BY   TUITION RATE          (031) GIVING  TOTAL TUITION             (033)  FROM 01 THRU 05
ADD          TOTAL TUITION         (033) AND  TOTAL TUITION + FEES  (035) GIVING  TOTAL TUITION + FEES      (035)  FROM 01 THRU 05
INSERT IN    FEES                  (032)        100,280.00                                                        FROM 01 THRU 01
INCREASE     FEES                  (032) BY       003. PERCENT                                                        FROM 02 THRU 05
ADD          FEES                  (032) AND  TOTAL TUITION + FEES  (035) GIVING  TOTAL TUITION + FEES      (035)  FROM 01 THRU 05
ADD          TOTAL TUITION + FEES  (035) AND  ** TOTAL ALL INCOME   (040) GIVING  ** TOTAL ALL INCOME       (040)  FROM 01 THRU 05
INSERT IN    OTHER INCOME          (037)         22,300.00                                                        FROM 01 THRU 05
ADD          OTHER INCOME          (037) AND  ** TOTAL ALL INCOME   (040) GIVING  ** TOTAL ALL INCOME       (040)  FROM 01 THRU 05
INSERT IN    FEDERAL GOVERNMENT    (038)        142,434.00                                                        FROM 01 THRU 01
INCREMENT    FEDERAL GOVERNMENT    (038) BY       8,500.00+                                                       FROM 02 THRU 05
ADD          FEDERAL GOVERNMENT    (038) AND  ** TOTAL ALL INCOME   (040) GIVING  ** TOTAL ALL INCOME       (040)  FROM 01 THRU 05
INSERT IN    INTEREST              (053)         92,000.00                                                        FROM 01 THRU 02
INSERT IN    INTEREST              (053)         88,000.00                                                        FROM 03 THRU 05
ADD          INTEREST              (053) AND  ** TOTAL ALL INCOME   (040) GIVING  ** TOTAL ALL INCOME       (040)  FROM 01 THRU 05
INSERT IN  . ** TOTAL ALL INCOME   (040)      5,294,154.00                                                        FROM 01 THRU 01
INCREASE     OTHER EXPENSES        (101) BY       010. PERCENT                                                        FROM 01 THRU 05
INCREASE     ALL STAFF SALARIES    (102) BY       007. PERCENT                                                        FROM 01 THRU 05
ADD          OTHER EXPENSES        (101) AND  ALL STAFF SALARIES    (102) GIVING  TOTAL EXPENDITURES        (050)  FROM 01 THRU 05
SUBTRACT     TOTAL EXPENDITURES    (050) FROM ** TOTAL ALL INCOME   (040) GIVING  BALANCE FOR YEAR          (061)  FROM 01 THRU 05
ACCUMULATE   BALANCE FOR YEAR      (061) INTO BALANCE ACCUMULATED   (062)                                             FROM 01 THRU 05
ADD          BALANCE FOR YEAR      (061) AND  FUND EQUITY JULY 1    (064) GIVING  ACCRUAL FUND EQUITY       (065)  FROM 01 THRU 01
SHIFT        ACCRUAL FUND EQUITY   (065)                                  GIVING  FUND EQUITY JULY 1        (064)  FROM 01 THRU 01
SHIFT        ACCRUAL FUND EQUITY   (065)                                  GIVING  FUND EQUITY JULY 1        (064)  FROM 02 THRU 02
ADD          BALANCE FOR YEAR      (061) AND  FUND EQUITY JULY 1    (064) GIVING  ACCRUAL FUND EQUITY       (065)  FROM 02 THRU 02
SHIFT        ACCRUAL FUND EQUITY   (065)                                  GIVING  FUND EQUITY JULY 1        (064)  FROM 03 THRU 03
```

Figure 5

SIMULATION OUTPUT

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       JJC 5 YEAR PLAN                         JOLIET JUNIOR COLLEGE                      10/28/77                  PAGE  1
PLANNING ITEM          NO.    BASE YEAR        77-78           78-79            79-80            80-81            81-82
*********************   99
*********************   99
                        95
** ACCRUAL ANALYSIS     96
                        95
*********************   99
ASSESSED VALUATION       4
                        95                    2,322.00         2,522.00         2,622.00         2,722.00         2,822.00
** LOCAL GOVERNMENT      3
                        95
TAX RATE                 5
LOCAL TAXES              8     1,250.00       1,459.00         1,532.00         1,704.00         1,733.00         1,950.00
                        95                3,286,144.04     3,747,792.88     4,333,851.36     4,575,709.22     5,337,813.03
CHARGE BACK REVENUE      6
                        95                  101,850.00       101,850.00       101,880.00       101,850.00       101,850.00
TOTAL LOCAL GOVNMENT     7
*********************   99                3,395,514.04     3,857,142.88     4,443,201.36     4,685,059.22     5,447,163.00
STATE APPORTIONMENT     10
                        95                3,091,908.00     3,246,503.40     3,408,888.57     3,579,269.99     3,758,233.48
TOTAL DVTE              21
                        95   130,294.00     182,000.00       188,250.00       194,500.00       200,750.00       207,000.00
STATE WORK STUDY-ETC    23
                        95    13,876.00      47,713.00        47,713.00        47,713.00        47,713.00        47,713.00
INMATE TRAINING PROG    57
                        95                  249,000.00       251,490.00       254,004.90       256,544.94       259,110.38
TOTAL STATE GOVNMENT    22
*********************   99                3,670,621.00     3,733,956.40     3,905,066.47     4,084,277.93     4,272,056.86
** TUITION AND FEES     30
                        95
TOTAL TUITION HOURS     58
TUITION RATE            31                  150,570.00       155,087.10       159,739.71       164,531.90       169,467.85
                        95        13.00          13.00            15.00            15.00            16.00            16.00
TOTAL TUITION           33
                        95                1,957,410.00     2,326,306.50     2,396,095.65     2,632,510.40     2,711,485.60
FEES                    32
                        95    31,000.00     108,920.00       112,167.00       115,552.01       118,997.97       122,567.80
TOTAL TUITION + FEES    35
*********************   99                2,066,330.00     2,438,473.50     2,511,647.66     2,751,508.37     2,834,053.40
                        95
                        95
** OTHER INCOME         36
                        95
OTHER INCOME            37
INTEREST                43   103,451.00      22,300.00        22,300.00        22,300.00        22,300.00        22,300.00
FEDERAL GOVERNMENT      38   100,000.00      92,000.00        92,000.00        80,000.00        80,000.00        80,000.00
                        95                  142,434.00       133,934.00       125,434.00       116,934.00       108,434.00
** TOTAL ALL INCOME     40
                        95                9,294,156.00    10,277,806.78    11,087,689.49    11,740,079.52    12,766,007.36
*********************   99
                        95
** EST. EXPENDITURES    41
                        95
OTHER EXPENSES         101 2,369,931.00 - 2,606,924.10     2,867,616.51     3,154,378.16     3,469,815.97     3,816,797.56
                        92
```

Figure 6

The printed PLANSIM reports are used by the college president, his vice-presidents and deans and even the college board. Many important decisions have been facilitated by the PLANSIM system. Decisions to raise the student/teacher ratio, to increase tuition and to seek a tax referendum were done after much study, deliberation and PLANSIM.

Summary

In summary, Joliet Junior College has implemented several new systems at a relatively modest cost. The benefits of these systems has been manyfold with actual dollars saved occurring immediately. The output from these systems has been used by the highest ranking college administrators to make key decisions. So if low cost, high benefit, and decisions by high ranking personnel are important, these systems have been a success at Joliet Junior College.

Social Cost of Computer Technology

York Wong
The Evergreen State College
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Efficiency and productivity have transformed systems analysts and programmers into workers in an "Information Processing Factory" where jobs are increasingly routinized, monitored and controlled. Work becomes instrumental; something done for pay to meet the daily needs. The computer profession is no longer a means - if such a Golden Age ever existed - to realize our potential as human beings and to create socially useful products.

The social cost for organizational efficiency and productivity is the frustration of performing progressively meaningless tasks. We must overcome these "white collar blues" by designing new systems with the worker's needs in mind.

Social Cost of Computer Technology

I. General

The situation is not well in paradise. The world of computer programmers and systems analysts is being turned upside down. Once, we were the envy of the workforce: good pay, flexible hours and job status. We went around telling each other that we were at the "cutting edge" of knowledge.

Today we are fed up, frustrated and insecure. We find ourselves doing the same things day after day, and we are not even appreciated by the organization -- neither in the pocket book nor in rank.

What happened? Why have we fallen so far? Unfortunately, very few answers are offered in the standard literature. Generally we are told:

> "It is the economy. Things will be rosy again after this recession."

> "It is the maturing field. We are catching our breathe before the next takeoff."

> "It is the state-of-the-art. Only the boys are being separated from the men."

I believe that these writers are over optimistic. I don't think that we are going through a passing phase because I see the current dilemma as a normal development in the data processing profession. Furthermore, I maintain that the situation will get worse.

II. Thesis

The purpose of this essay is to demonstrate that technology in general, and computer technology in particular, creates alienated workers. Far from carrying out intellectually challenging activities toward socially useful goals, programmers and systems analysts are instead doing routine tasks -- something that must be done for pay to meet their daily needs. Like the "blue collar" worker complaining about his factory job, we too sing our "white collar blues" after performing the same kind of assignments day after day. Furthermore, these job structures are not accidental and temporary developments, but are direct results of two basic reasons we use technology, namely to obtain greater efficiency and productivity out of the man/machine process.

I will show that efficiency and productivity are the major causes of unhappy workers in computer technology by forcing an assembly line approach to systems analysis and programming, and by dividing each project, each skill and each operation into progressively simpler tasks. As in the factory, strict standards, routines and documentation are imposed onto the computing process; control and technical skills have been all but removed from the workforce, and placed instead at the top of the organization.

III. Methodology

I will use the following approach to show that the quality of work life in the data processing field has greatly deteriorated:

First, I will define four major job motivators: why do people really want to work anyway?

Secondly, I will offer evidence to show that the quality of work, using these indicators as measures, is failing.

Thirdly, I will demonstrate that culprits are the constant drives for efficiency and productivity.

IV. Why do people work?

I propose that we work ....

1. .... partly for pay and security,
2. .... partly because we find the work interesting,
3. .... partly because we want to create socially useful products,
4. .... partly because we want to gain the respect of others through the work we do.

If a job pays well, is relatively secure, interesting, creates useful products for society and carries a high status, then we will very likely find a happy and willing worker at the position. But the reverse is equally true: putting a smart person into a dumb situation is a sure way to get him frustrated. For many of us, this is the developing trend in data processing.

V. Pay and job security

The trend in wages for computer personnel is deteriorating. The programmer, for example, was once at the top of the professional scale. Today, he starts at the same level as the clerical worker. Even the experienced programmer now finds plenty of company in his salary level -- if he is able to find a job at all. Raises are also coming in longer intervals, and in smaller chunks. A 10-year salary analysis for the computer field can be seen in the following data:

10-Year Comparision of Rising DP Salaries, the National Workforce and the Consumer Price Index (CPI)

	Base Year = 1967 % Increase 1967-1976
Data Processing Managers*	64%
Senior Systems Analysts*	73%
Senior Programmers*	66%
Senior Computer Operators*	67%
National Workforce (Non Farm)**	91%
CPI**	74%

* From 1976 Infosystem Salary Survey. ** From Business Condition Digest.

It can be seen from this data that despite the seemingly large increase in DP salaries between 1967-1976, the computer people actually trailed the national average. Furthermore, the pay raises did not even keep up with inflation or, to put it another way, there has been an actual loss in earning power.

The usual explanation for the data is the standard economic argument of supply and demand: there are more computer people now than ever before, and the competition is keeping a healthy lid on (computer) people cost. While we cannot reject the simplistic logic of this argument, we should take it a step further and ask: why did the supply of computer people go up?

I think the supply went up to cope with the factors in efficiency and productivity. After all, there is nothing more disruptive to both efficiency and productivity than having someone quit on you in the middle of a job, and not finding anyone around who can take it over. The solution to this problem is the "great training binge" which began in the early 1960's, and still continues today. During this period, literally thousands of Americans were trained in systems analysis, programming and computer operations. But the key which made it all possible was that training was transferred from the private to the public sector. Thus two direct benefits were realized: an ample supply of technical workers without an enormous investment of in-house training cost.

Some early signs of this movement were:

1. Computer manufacturers donating used equipment to high schools and community colleges.
2. Professional journals offering guidelines on basic data processing training.
3. Promotional activities supported by computer manufacturers such as local computer fairs.
4. Emergence of programmed-instructions texts. As one writer pointed out in 1963: "The p-i approach is a workable solution to the acute training problem in that a large number of people can be trained in a short period of time at a moderate cost."
5. Formal curriculum designs were seriously debated in such professional journals as the ACM.
6. The "bright and unlimited" future of being a "data processor" began its uninterrupted image in the marketplace.
7. Federal funds used to train keypunch operators in many economically depressed areas.

It got everyone into the training act, but mostly the public institutions took over. Today, almost every college and university offers some computing instructions. There are over 100 colleges granting undergraduate degrees in Computer Science, and another 100 universities with graduate studies in the same area. On top of this, there are over 800 private data processing institutes offering courses in computer programming. Very quickly, the industry got all the people it needed.

This analysis, by no means, suggests that we have learned how to build a perfect systems analyst or programmer ! It merely points out the driving forces of efficiency and productivity behind the economics, and the main reasons for the falling wages and job insecurity today. Training continues to take place in every company today, but the emphasis is on fitting the worker into the new environment, e.g. workshops on the nature of the business and meeting with the users, rather than on basic technical skills.

VI. The Quality of Work

The quality of work in the computer profession has greatly deteriorated due to the assembly-line approach to systems and programming.

# We are becoming specialists with narrowly defined skills.
# We seldom understand how our work is related to others in the organization.
# We have little control over the work process.
# We are forced to work with an antiquated prog. language.

Yet the assembly-line is both efficient and productive. By breaking down the formerly complex tasks in systems analysis, programming and operations-- all of which were done slowly --, into a series of simple and repetitive tasks -- all of which can now be done quickly --, the new structure is supposed to be less prone to errors (reliable), can be carried out faster with the aid of the computer (efficient), can be assigned to worker with the minimum skills required (economy), and can be accurately monitored (control). Such a system, transplanted from the factory to the computer profession, now finds separate groups of systems analysts, programmers, operators and key-entry staffs assigned to separate phases of the project. Furthermore, each group is in turn graded according to skill level. Thus there are lead, senior, junior and trainee programmers within the programming group and similar divisions in the other areas. Although some mobility occurs within each group, the occupant of a specific job category usually finds his authority, responsibility and skill level narrowly defined. For example, the programmer in all but the smallest installations typically receives his assignment from the systems analyst, and in turn prepares the program for the operator. He seldom participates in face-to-face negotiations with the user, and almost never inside the computer room when the program is on the machine. In fact, the bulk of the data processing personnel does not participate in the production process being automated, hence problems confronted in the real world do not become their own. Under these conditions, we often find ourselves solving abstract problems with little connection to concrete situations, and only fuzzily related to other people solving other abstract problems. We do it eight hours a day, five days a week for 50 weeks a year. Crazy?

Talk t the maintenance programmer, or the tape librarian, or the JCL specialist...

Another reason why computer work -- programming, in this case-- is getting boring is COBOL, that antiquated language we are forced to use. It is truely the uninvited guest who refuses to leave because everything else in the computing system has become more sophisticated except COBOL. But many companies today still use nothing but COBOL, and it is estimated that nearly 80% (maybe more) of all business applications are written in COBOL.

Nobody liked COBOL in the first place!

For one thing, we knew what a problem oriented, machine independent language would do to our job. It would take the craft out of progrmming and, along with JCL and O/S, would all but remove the creative skills from the profession. The handwriting was on the wall as far back as in 1964 when a programmer wrote in DATAMATION:

"Where once stood a proud and unconquerable soul
There now stands a coder without core control
A victim of FORTRAN and all that it means
This new greedy monster controls the machine."

The answer came in an article in March, 1967. Howard Bromberg, in an essay titled,"The COBOL Conclusion", proclaims what everyone already knew: "COBOL exists. It works. It grows."

COBOL will stay as long as it is cost effective; as long as the company equates productivity with readily generated programs; and as long as conversion from the existing stockpile of COBOL programs to another language remains a problem. The social cost of imposing an out of date tool on the workers, and thus limiting their creative potential, will be ignored.

VII Socially Useful Work

The issue of whether we are creating socially useful products is moot because it contains the implicit assumption that we have control over the kind of things we wish to do with the computer. Clearly, we don't. The computer is owned by somebody else and it costs a lot of money. And unless it can pay for itself through its contribution to the company's efficiency and productivity, it won't stay around for long. In the "real world" of data processing, we have little to say about our assignments.

The irony is that we have been telling each other and to the world that computers will advance the frontier of science and knowledge — that they can be used to solve our social needs. Sometimes we even offer "process solutions". An example: there is an excellent computer program for matching the job seekers skills with the available positions. If he is not qualified for any opening, the computer will then direct him to a training center. Sounds like a tremendous way to cope with the unemployment problem, right? Wrong! Because it doesn't matter how sophisticated the computer system is, the fact remains that there aren't enough jobs to go around. All the computer does in this instance is to give the applicant a quick "no" answer. The perfect "process solution" turned out to be irrelevant because the content is missing.

As long as we can only dream up processes but could do nothing about the content, we cannot call our work socially useful.

VIII. Status of Work

Respect for computer people has taken quite a plunge in the past 20 years. At one time -- perhaps the Gold Age of Computing, in the late 50's and early 60's -- the programmer was king. He was the brilliant eccentric, the prima donna taming the "giant brain". He was worth his weight in gold. Nobody complained if he wore his hair long, brought his rocking chair to work at odd hours of the night. Do not disturb -- genius at work.

And today ? There are now over 500,000 programmers, systems analysts and what-have-you, "interchangeables" to be plugged into any project. The sad truth is that the majority of computer personnel aren't even considered as professionals anymore:

The Department of Labor ruled in 1972 that systems analysts and programmers are non-exempt employees, i.e. they are part of the classified staff under the civil service system.

The Harvard Business Review, in a 1973 article titled, "Plight of the EDP Manager", placed the computer personnel into three skill groups: the bottom group of KP and other clerical workers; the medium skill group of operators, programmers and systems analysts; and the top group of "highly skilled, educated and motivated software experts".

The status of programmers and systems analysts in academia is also suspect. The typical curriculum in Computer Science is full of theoretical studies in math, information science and operations research. Programming and basic systems analysis are often considered as practical workshops. And here is the final dilemma:

If you are not properly certified by a degree in Computer Science -- preferably an advanced degree --, then you are not considered a card carrying member of the profession.

But, if you do have such a degree and all that training behind it, then the chances are that you will be over-qualified on the job. (Remember: putting a smart worker into a dumb situation is a sure way to get him frustrated !)

Bad news all around. Such is the social cost of computer technology.

APPLYING COST/BENEFIT ANALYSIS TO SHARED FINANCIAL SYSTEMS:

A CASE HISTORY

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The University of Wisconsin-Madison provides shared financial and business services support to several campuses of the University of Wisconsin System. This presentation describes the methodology used in a University of Wisconsin-Milwaukee feasibility study designed to evaluate the costs/benefits of providing the systems and operational support locally vs continuing the shared services arrangement.

I. BACKGROUND TO THE CASE

In 1971 Governor Patrick Lucey signed legislation merging two Wisconsin systems of higher education--the University of Wisconsin and the Wisconsin State University systems. This new system--The University of Wisconsin System--consists of 13 four-year campuses, 14 two-year campuses and a state-wide extension operation. At merger, the two governing boards and two central administrations were combined into one.

Although both former central administrations had much in common (e.g., they both had to deal with the state bureaucracy), there were also many differences. This was particularly notable in the business and financial operations. The former University of Wisconsin Central Administration tended to be more operationally-oriented than their Wisconsin State University counterparts. This operational focus tended to be counter to the role of Central Administration as envisioned in the merger legislation which read in part:

> "Central administrative responsibility in providing services to the separate institutions should be held to a minimum, but cooperative service arrangements among the campuses should be encouraged."

Therefore, an early task of the newly formed Central Administration was a thorough review of its operational responsibilities.

One of the first results of this effort was an agreement between Central Administration and the Madison campus to transfer certain business office departments and the supporting administrative data processing operation from Central to the Madison campus, effective March, 1972. These business and financial functions, listed in Figure 1, had provided services to the former University of Wisconsin units: the four-year institutions at Madison, Milwaukee, Racine-Kenosha (Parkside), and Green Bay; the two-year center system; and the state-wide extension operation based in Madison.

Key features of the transfer were:

A. Central Administration would relinquish all of its line responsibilities for those areas being transferred.

B. Although the operating responsibility was given to the Madison campus, the business and data processing operations transferred would continue to provide services to all units formerly served, including Central itself.

C. The transferred business service departments and administrative data processing operation would continue to operate as an integral unit.

D. The immediate transition was to be made without disruption of service.

E. The funding for the operations would follow the shift; however, a unit equity would be computed and would be available to the units should there be a subsequent shift of a function from the Madison business office to some other unit's business office.

The individual unit equity amounts were primarily determined by allocating each department's budget according to relevant work-load indicators. This resulted in the following equity for Milwaukee (based upon 1971-72 budget data):

	MILWAUKEE	TOTAL
Business Office Functions (combined)	$114,300	$1,614,800
Administrative Data Processing	112,700	1,018,700
TOTAL	$227,000	$2,633,500

It was recognized that the equity amounts would require revisions because of the natural growth of the budget (e.g., funded salary and inflationary increases). However, new demands imposed by the State, Central, or the units themselves would be provided only to the extent they are reimbursed by the units involved.

The Milwaukee campus recognized this transfer as an opportunity to fix responsibilities in a number of areas where there had been problems in campus-central relationships. The Milwaukee Assistant Chancellor for Business Affairs requested a study to determine the circumstances and conditions under which portions of the operations would be shifted to the campus and what relationships would have to be worked out with the Madison Campus. It was decided that a feasibility study would be conducted. The objective of this study was to determine the requirements if Milwaukee were to provide the former central business and financial services on the campus. The task of coordinating the study was assigned to two members of the Assistant Chancellor's staff: his senior assistant and his business systems director.

II. THE FEASIBILITY STUDY

A. PLANNING FOR THE STUDY

The two individuals designated to coordinate the study, recognizing the complexity of the task, sought maximum involvement of the business office and data processing staffs from both the Milwaukee and Madison campuses. The final plan that was developed organized the project as follows:

1. Fact-finding—determine the scope of the functional services (both operational and data processing) presently provided by the campus and those provided to (and for) the campus by the

counterpart Madison (Central) function.

2. Analysis—determine the requirements (cost, benefits, constraints, etc.) for assuming these Madison functions on the Milwaukee campus.
3. Report—organize the results of the fact-finding and analysis phases into a report that can be used for decision-making purposes.

This plan was developed in consultation with the various Milwaukee business office department heads and the Computing Services Director. Final concurrence was obtained from the Assistant Chancellor. The following sections will provide more detail on the three phases of the study.

B. FACT-FINDING

As indicated, the purpose of this phase was to determine the scope of the functional services presently provided by the campus and those provided to (and for) the campus by counterpart Madison (Central) functions. It is important to note that the data processing operation was not considered as a separate function; rather, each appropriate data processing system was considered with the function to which it related. For each function, Milwaukee and Madison project contacts in both the business offices and data processing operation were identified. The business office contacts were, for the most part, department heads of the related functions. The data processing contacts were primarily analysts/programmers who had experience with the various functions under study.

To start the process, a meeting was held with the Milwaukee project contacts. The purpose of this meeting was to explain thoroughly the project plan and to request documentation from each of them on the function they provide. This document was to contain the following:

1. Name of the function
2. Mission/goals
3. Responsibilities
4. Services provided
5. Relationships with the Madison (Central) counterpart function

After these documents were received and reviewed, the next step was a series of meetings with both Madison and Milwaukee functional project contacts. The purpose of these meetings was to obtain a better understanding of the services provided to or for the campus by their Madison counterparts. These meetings resulted in the Milwaukee project contacts developing a document similar to the above for the Madison function.

The two documents were then combined by the project coordinators into an integrated document describing the function in its entirety. Three things became apparent from this combined document:

1. overlap or duplication of services between the two campuses (as well as some gaps);
2. the interrelationships with other functions (e.g., payroll with budget control); and
3. a better understanding of services provided for the campus by the Madison function (e.g., liaison with state-level functions).

Armed with this documentation, the project team was ready to enter the analysis phase.

C. ANALYSIS

As previously indicated, the purpose of this phase was to determine the requirements (costs, benefits, constraints, etc.) for assuming the Madison (Central) functions on the Milwaukee campus. To start, each of the Milwaukee business office contacts was asked to review the results of the fact-finding phase for completeness. In addition, the contacts were asked to provide the following information on their function:

1. costs involved in absorbing the Madison counterpart function (Costs were to include all required resources--budget, personnel, equipment, space. It was indicated that this should be a reflection of needs without regard to the computed equity figure.);
2. any intangible costs/benefits that would result from the transfer of the counterpart function; and
3. any constraints that could be identified.

The Milwaukee Computing Services project contacts were also asked to develop similar information for the four systems involved: accounting control, payroll, extramural support, and capital equipment inventory. An important part of the study was the assumption that the existing Madison data processing systems would be transferred to the Milwaukee campus. That is, no provision was made at the time for in-house development, exchange of software with another institution, or purchase of commercial software. Computing Services was asked to determine the costs and manpower to make the existing systems operational on the Milwaukee campus as well as to determine the ongoing annual production and maintenance costs.

Once the necessary documentation was received from the project contacts, the project coordinators attempted to weave the various reports together and to determine priority and organizational implications for a final summary and recommendation to management. The feasibility study was now ready to be put in final form.

D. REPORTING

It was determined that the final report would have three major sections:

1. Introduction—written by the project coordinators
2. Analysis by function—edited by the project coordinators from material prepared by the Milwaukee project contacts
3. Summary and recommendations—written by the project coordinators in consultation with the project contacts.

It is appropriate to describe the last two sections in some detail. The outline of the function-by-function analysis is contained in Figure 2. This is a summary of the output of the fact-finding and analysis phases. An important point to note is that it contains the Milwaukee business departments' and Computing Services' recommendations on the proposed shift.

In the summary section of the report, the project coordinators pointed out that:

1. There exists strong interrelationships among the functional areas as well as between an operational function and its data processing support system (Figures 3A and 3B contain a generalized model simulating the present and proposed information flow).
2. The assumptions used for the cost estimates:
    a. The operational function costs assumed the transferring of all operational and data processing functions, the removal

of all identified constraints, providing the same level of service, and, where possible, improving the timeliness and accuracy in providing the Madison (Central) service.

  b. The data processing cost estimates assumed the operation of the same Madison (Central) systems on the Milwaukee campus (except that the teleprocessing capability would not be available at Milwaukee).

3. The full effect of the merger and the resultant reorganization of Central Administration was not known at the time the study was done. For example, several of the business functions were subsequently transferred back to Central.
4. A major constraint might be an unwillingness of other functions of state government to work directly with the campus rather than through a central contact for the UW System.

The recommendation section contained the following:

1. A master plan and rationale for the function-by-function transfer of the business and financial services. The functions were grouped into three categories--near-term, intermediate-term, and long term. Key variables in the classification scheme used by the project coordinators were:
   a. Degree of duplication of work between the two campuses
   b. Unfunded costs (any costs not covered with equity transfers would have to come from base budget reallocations within the Milwaukee campus)
   c. The Milwaukee department's willingness to assume the function
   d. The complexity of the operational services

   e. The reliance on data processing support (see recommendation 2 below)
   f. The relationship of each function with the others
   g. The anticipated problems and complexities of working directly with state-level agencies

2. A request to do a follow-up study to develop alternate methods for providing the necessary systems support. The project coordinators concluded it was infeasible to transfer the Madison (Central) systems to the Milwaukee campus on a one-for-one basis. Alternatives suggested included:
   a. Continued use of the Madison systems (a 'service bureau' arrangement)
   b. In-house development
   c. Exchange of software with another institution
   d. Purchase of commercial software

The final report was presented to management six months after inception of the project.

III. SUMMARY AND CONCLUSION

The feasibility study described was conducted five years ago. As one of the project coordinators, I feel I can take the liberty to constructively criticize the study. Looking back, what were the most positive points? What would I change?

On the positive side, I feel the most important contribution to the success of the project was the active involvement of the Milwaukee project contacts. These individuals spent many hours assisting in gathering data, analyzing it, and preparing the necessary documentation. Their recommendations became an integral part of the final report.

Subsequently, decisions to shift or not shift functions were understood and supported by all. Another positive point was the acquisition of a thorough understanding of the services provided for the Milwaukee campus by the counterpart Madison (Central) function. None of the Milwaukee project contacts fully realized the scope of this involvement. Gaining this understanding led to a more complete and accurate analysis of the requirements for assuming the function on the Milwaukee campus.

If we were to conduct the study today, there are several things I would do differently. First, I would try to secure greater assistance from the Milwaukee Computer Services operation. Although this group fully supported our task, due to the press of other priorities, they were unable to make sufficient manpower available for this project. This prevented us from fully examining all the alternatives for securing the necessary data processing systems assistance. Hence, we limited our analysis to the assumption that we would transfer the existing Madison systems to Milwaukee on a one-for-one basis. It soon became apparent that this was not feasible. Consequently, as stated in the recommendation section of the report, the project coordinators requested that a follow-up study be conducted in order to address other possible alternatives. Second, I would spend more time during the planning stage surveying the complexity of the task. At the outset of the project, the Milwaukee project contacts did not fully appreciate the interrelationships among the various business and financial services. We came to realize that these operational and data processing functions represented a very complicated and sophisticated maze of procedures with almost all departments closely interwoven into the system. It was the creature of over 100 years of development for its roots began with the founding of the University of Wisconsin. This original naiveness was one of the main reasons why the project timetable was increased from a planned estimate of three months to the actual six months. In addition, the interrelationships we discovered had a strong impact on the master plan for the functional transfers.

There is nothing very original in the methodology illustrated in this case history; however, you may benefit from reviewing this practical example of its use. Although this paper described a very specific application of cost/benefit analysis, it is my hope that you will be able to draw some generalizations from it.

ACKNOWLEDGEMENT

The author wants to offer his special thanks to Alfred Fiorita, who served as the other project coordinator of the feasibility study described in this case history.

BUSINESS FUNCTIONS STUDIED

*BUDGET CONTROL

BURSAR

DISBURSING

GENERAL SERVICES AND COMMUNICATIONS

*PAYROLL

PRE-AUDIT

RISK MANAGEMENT

*RESEARCH ADMINISTRATION-FINANCIAL

INDIRECT COST STUDIES

CONSTRUCTION ACCOUNTING

*CAPITAL EQUIPMENT INVENTORY

*INCLUDES SUPPORTING DATA PROCESSING SYSTEMS

Figure 1

FORMAT FOR FINAL REPORT

I. FUNCTION NAME

II. EXISTING RESPONSIBILITIES
    A. GOAL
    B. SERVICES/TASKS
        1. MILWAUKEE
        2. MADISON
    C. MILWAUKEE CURRENT COSTS
    D. MILWAUKEE EQUITY IN MADISON FUNCTION

III. DEPARTMENT'S EVALUATION OF PROPOSED SHIFT
    A. ESTIMATE DIRECT COST TO ASSUME FUNCTION
    B. SPACE REQUIREMENTS
    C. INTANGIBLE COSTS
    D. CONSTRAINTS
    E. BENEFITS
    F. DEPARTMENT'S RECOMMENDATION

IV. COMPUTING SERVICES' EVALUATION OF PROPOSED DATA PROCESSING SYSTEM SHIFT
    A. SYSTEM SUMMARY
    B. MILWAUKEE EQUITY IN MADISON SYSTEM
    C. COSTS/MANPOWER TO MAKE PRESENT SYSTEM OPERATIONAL
    D. ONGOING PRODUCTION/MAINTENANCE COSTS
    E. CONSTRAINTS
    F. BENEFITS
    G. COMPUTING SERVICES' RECOMMENDATION

Figure 2

INFORMATION FLOW MODEL

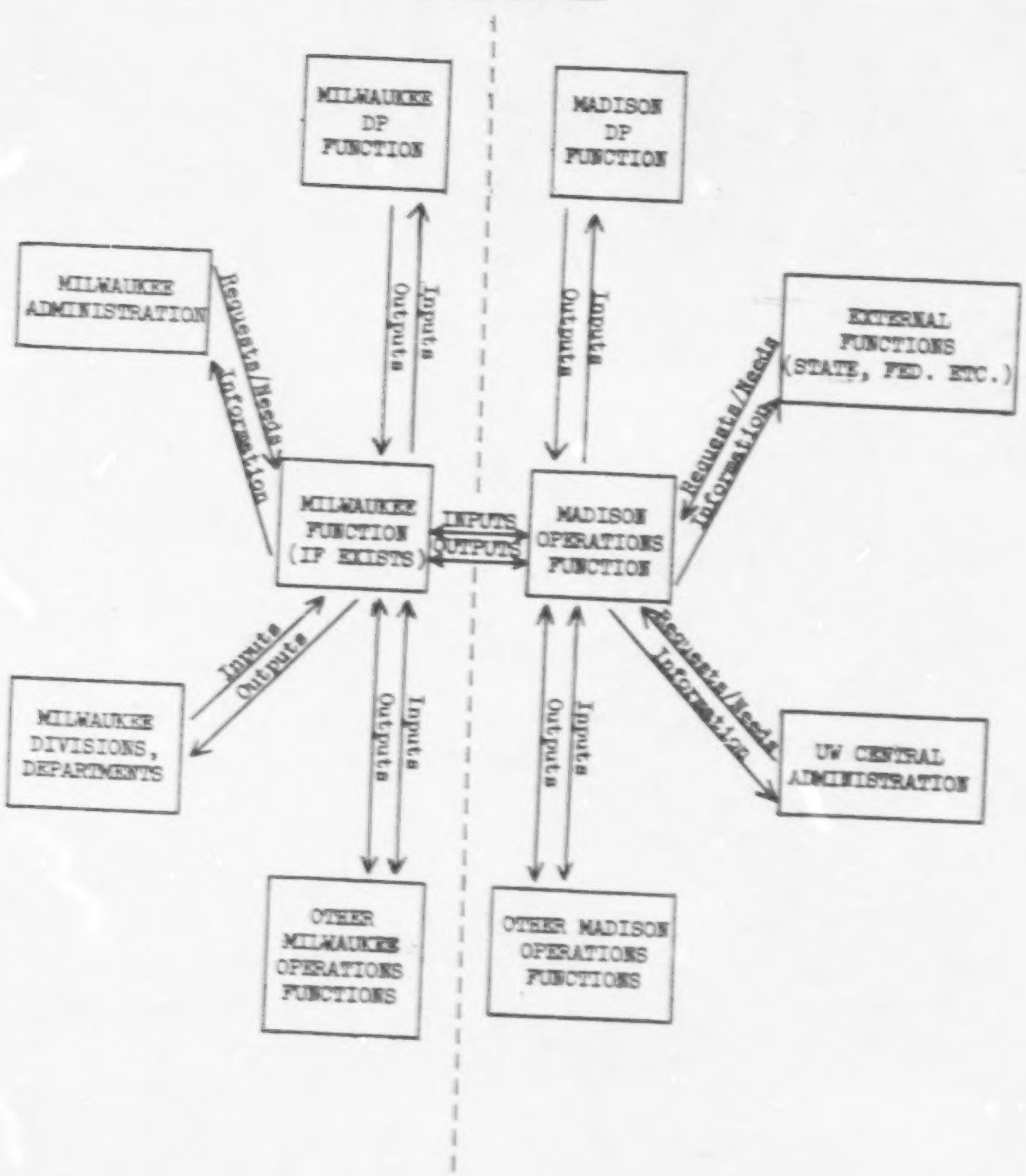
PRESENT
MILWAUKEE DP FUNCTION
MADISON DP FUNCTION
MILWAUKEE ADMINISTRATION
EXTERNAL FUNCTIONS (STATE, FED. ETC.)
Requests/Needs
Information
Inputs
Outputs
MILWAUKEE FUNCTION (IF EXISTS)
INPUTS
OUTPUTS
MADISON OPERATIONS FUNCTION
MILWAUKEE DIVISIONS, DEPARTMENTS
UW CENTRAL ADMINISTRATION
OTHER MILWAUKEE OPERATIONS FUNCTIONS
OTHER MADISON OPERATIONS FUNCTIONS

Figure 3A

INFORMATION FLOW MODEL

PROPOSED

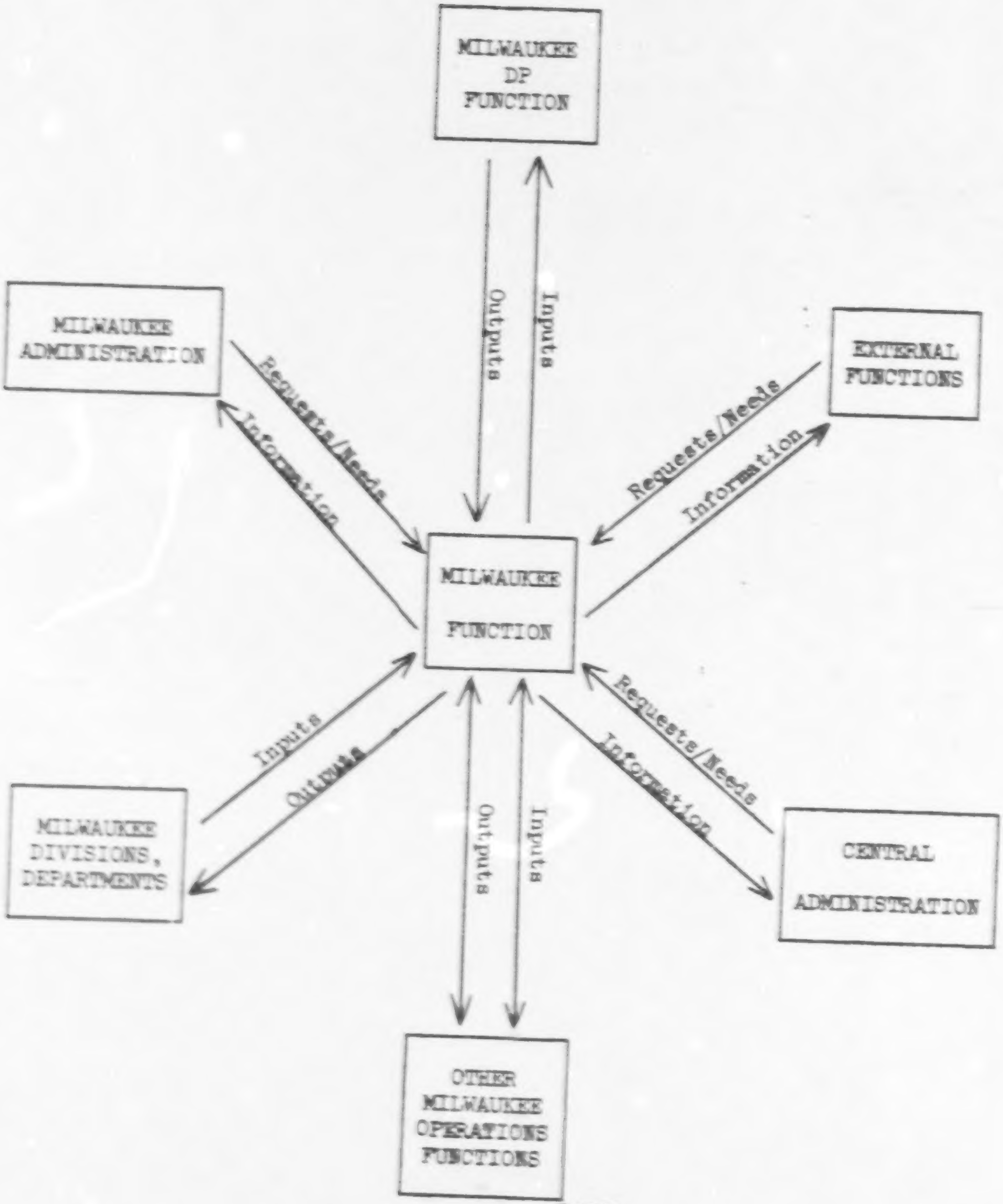
MILWAUKEE DP FUNCTION
Outputs
Inputs
MILWAUKEE ADMINISTRATION
Requests/Needs
Information
EXTERNAL FUNCTIONS
Requests/Needs
Information
MILWAUKEE FUNCTION
Inputs
Outputs
MILWAUKEE DIVISIONS, DEPARTMENTS
Outputs
Inputs
Requests/Needs
Information
CENTRAL ADMINISTRATION
OTHER MILWAUKEE OPERATIONS FUNCTIONS

Figure 3B

DESIGNS FOR PRESERVING BENEFITS IN INFORMATION SYSTEMS EXCHANGE

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Sharing the costs of information systems through cooperative development and exchange holds great promise. Direct management benefit derives from the ability and authority to initiate action based on the information. Hence, the effectiveness of an information system is critically dependent on the extent to which its data structures parallel the user's management organization. Experience is drawn from cooperative developments in the California State University and Colleges system and exchange efforts between university systems in other states. Some crucial design details emerge to guide cooperative systems planning that should improve the sharing of benefits as well as costs.

The purpose of this paper is to share some thoughts accrued over the past eight years while serving as Computer Center Director at one campus of the California State University and Colleges (CSUC) system. There are some geographic reasons for having multiple campuses spread over 1000 miles, but a more basic reason is that all campuses cannot be all things to all people. Differences in emphasis areas, size, instructional approach, organization, degrees of diversity, and most important, management style distinguish the campuses. A computing network spanning the 19 campuses is coordinated by the Division of Information Systems at the Chancellor's Office. The network resources have been described previously by the division director (1).

A key motivating force in our coordination efforts and in the creation of a distributed computing network lies in the potential for sharing systems and software developments. From time to time, I have been intensely involved in the sharing effort, and I have broadened my own perspectives on the trials and tribulations of shared development costs and joint benefits through fairly lengthy educational systems consulting projects in other states and provinces. I have tried to find a few common threads in these experiences that warrant further attention, but I should emphasize that my comments stem from my own perhaps biased perspective and do not reflect official (or even unofficial) positions of the institutions viewed. With that disclaimer, I will offer my heretic views of the history of our CSUC sharing efforts.

When we banded together with some hope of resource, cost, and benefit sharing, the first clear issue confronting us was that each university had already developed systems to satisfy their own most critical information processing needs. The developments reflected the differences in programs, organization, and scope, but differences in management style were, in the abstract, of greatest significance. Each of us had already satisfied our most pressing requirements, but there were countless opportunities for improvements and extensions to our existing information systems. We launched some joint efforts toward that end, and discovered how difficult it was to design an extension to fit any two different existing systems, let alone 19.

Any system we use must be fed some data. Since the basic elements of data identifying students, personnel, and physical resources were already collected for our on-going processes, that same data must be fed to the new system, but our data elements didn't match. Failure to use the exact same data inevitably caused our system file updates and maintenance processes to get out of phase, with the all too familiar chaotic results. If we were to superimpose a new system on our existing systems and provide a data interface for efficient system performance and maintenance, uniform data elements and coding structures were a critical need. Mosmann has referenced the glimmerings of recognition of this need in several states (3). Without uniformity each campus must convert any extended or transplanted system to fit its existing systems. Conversion added costs to be deducted from the potential benefits of sharing.

Once a conversion was underway, it was rarely confined to the differences in data elements and their source; it went on to include a few minor changes for local campus convenience -- just a few changes, of course. (Although I seem to recall cases when transplants were not even recognizable as the same system.) Perhaps we needed a convenient rationalization for a development effort and who could fault us when our intention was to use a system with development costs already paid by a sister institution? (Moving a house may be cheaper than building one, but it certainly isn't free.) After a year or two of efforts and frustrations along these lines, most of us realized we weren't accomplishing anything. We gave up on system extensions.

Perhaps a problem was that in many cases we (or our campuses) weren't participants from the beginning of the system development effort. It is an established part of the "conventional wisdom" of computing that the user's satisfaction will be much higher if he is made a party to the crime. We would start over and develop a systems design that would provide benefits for all of us. When we tried to start from where we already were, it didn't take long to discover that we were in very different places; each of us had evolved our basic systems a little ways in one direction or another (but different directions, of course) toward the new common goal. We had to back off and seek a "lowest common denominator" as a starting point. When we did that, so little was left that the only rational approach remaining was to start from scratch and jointly develop a new system that would replace the existing system on each of our campuses. Our horizons were not limited to our own 19 campus system. Transplants from elsewhere were eagerly sought as well, but the same problems arose.

We met often and shared our collective thinking, and shared the development costs. Each of us, under pressure from the status quo styles of managementprevalent on our own campuses, had to insist on the inclusion of some particular quirk or feature without which, it was the perception of our campus, we couldn't operate. A pattern developed. At each meeting one campus or another would come up with a new feature or data element. Failure to include that feature or element would mean giving up something the campus management understood and was accustomed to having. True, the new system promised some other benefits, but they were unfamiliar and nebulous. Why give up something we have now for something we may not find useful? (A bird in the hand and all that.) My own perception of a few cases I examined is that the reluctance to change usually stemmed from an underlying concern for organizational responsibility. Perhaps the data would be provided by a different office or summarized and distributed by a different office. Perturbations to established pecking orders always constitute a threat. Territorial imperatives ordained that nothing we presently had could be given up. One campus or another would reluctantly have to threaten to pull out of the development consortium. That would destroy our sharing effort, so we would compromise and try to scratch that campus' particular itch. The systems grew! The magnitude and scope increased with every meeting, until ultimately we all pulled out of the consortium anyway. The system was so overwhelming in scope that no one could afford to support it. The data collection requirements in support of items for which our own campus had no perceived need was so great (and particularly in offices beyond the Computer Center) that the new system was viewed as a luxury we couldn't afford. Some of our monstrous systems never got off the drawing boards, some abridged versions (remember the early "implementations of ALGOL 60?") were independently pushed forward by one or two campuses, and unfortunately one or two were pushed forward to production status with the aid of central office staff. Most of these attempts shriveled or died under maintenance pressures and disuse. The benefits we had planned to share were nil.

What can be learned from this massive exercise in frustration? I think we all recognize that solutions must fit the environment as well as the problem. Can we find common solutions in uncommon environments? I don't think we can until our managements from top to bottom accept data and information as campuswide resources with values and obligations transcending individual domains of authority. In our top managements (and hopefully even in ourselves) we find the ability to assimilate available information and see its implications in the problem context. At lower levels we may find individuals reading reports in search of particular and precise answers. Perhaps this human characteristic cannot be overcome, but I think it can. If top management will view the information content with thoughtful perspective and make the decisions as to its adequacy or inadequacy to the institution, we can work within that overall context and find convenient compromises for formatting and presenting the supporting detail at lower administrative and working levels. The concept of data base administrator is a management step in this direction. Regardless of the title or presence of an individual in such a role, we need the pressures and perspective to accept information as such and to get beyond the constraints of report formats.

Fixation on format and detail over meaning and content are not unique to administrative processing. How many analysis of variance programs does your campus have? How many do you really need? Then why do you have so many? In earlier days I ranted and raved and decreed that we should standardize on one or two. Later as my hair turned gray I surrendered to the increased decibles of faculty protest finally to learn how painful it can be to pay the tuition of individual effort to use a new and different applications program. It is especially resented if that program does no more for that particular user than did the old familiar program. In the interests of economy and efficiency you might convince the faculty that they should pay that tuition for the common good, but when you try to select that common program you must decide, which program? Professor X needs statistic A, and Professor Y cannot possibly do without statistic B, and so on. Therefore, the only rational choice is to seize on the most all-inclusive, all-encompassing of the available programs. But now a new problem arises. Professor Y may not understand statistic A and it is very difficult for him to wave this unfamiliar statistic away from his class with the notion that it is unimportant or meaningless. Vested interests in output segments aren't unique to administrative processing.

My own early background was in scientific programming. In the aerospace industry of the time (had they divided their resources that way), entire computer centers could have been devoted to approximating the solution of the initial value problem in ordinary differential equations. I was charged with developing efficient and effective programs to be employed by the engineers and research scientists as company standards. Some programs with great elegance and accuracy were absolutely abhored by the users. By-and-large, the engineers in the factories couldn't care less how accurate or how elegant the program was, as long as the output points were precisely those that fit the graph paper they were using. If it wasn't the graph paper, it was some similar constraint for which they demanded output at precise points in preference to precise output. I discovered that many of our best-conceived programs has been altered to grotesque proportions, destroying all of their virtues to provide that simple output convenience. Similar attitudes were occasionally encountered in support personnel in the research labs, but as with our top management, I can't recall a single incident when the top level research scientists expressed concern with format over information quality.

There are other details that may be more susceptible to improvement efforts falling within our spheres of influence. I have commented briefly on coding structure in an earlier paper (2), but let me elaborate in this context. One of the most aggravating points that precludes the sharing of benefits in systems exchange is the building of programs on the foundation of particular code structures. One of the good things we have done in recognition of our earlier failure to establish and enforce data element standards is to settle on the HEGIS code as a reference taxonomy for comparison of our academic programs. I come from a campus that recently offered a major in "transportation engineering" within our School of Engineering and Technology. We also offered a major in "construction engineering" within our School of Architecture and Environmental Design. We did not have a major in "civil engineering", but when we examined the content of the two programs we did offer, both were given the HEGIS code 0908 for civil engineering. Those majors were established before I arrived on campus, so I really have no idea how that situation came about. I do know that our Dean of Engineering and our Dean of Architecture were both very powerful, very capable, and highly regarded administrators, and I understand that they were both interested in civil engineering. Perhaps some accommodation was made. The point at issue here (and I have found many similar circumstances on my own campus and elsewhere) is that if our administration receives a report concerning civil engineering, whom do they commend or hold accountable? While a report comparing civil engineering program costs on our campus with similar program costs on other campuses may be very valuable, if action of any kind is called for, we need a division of information matching our division of responsibility.

Very few management reports list disciplines such as "0908", but many management reports list disciplines such as "civil engineering." The alphabetic description matching a code structure appears in the system design detail as a table look-up. That same table entry effort can retrieve information other than program name. In fact, it can retrieve a code standardized to accommodate intercampus comparisons. It can include sort and summary keys as well. Coding can be of unlimited length to suit any or many needs with no inconvenience to the user since only an entry index is required after the initial code table provision. Such keys and codes can be locally assigned at the same time that a table of discipline names is provided by the using institution. This simple change will allow the same computer program to match different intra-campus organizational administrative structures without loss to the inter-institution comparisons by standard codes. It really works! (If such a simple idea needs a scientific foundation, note that the table entry amounts to "indirect addressing" which leads to a "relational data base.")

One question that is sure to be asked will be, "Is structured programming and structured design an answer?" It is not when the basis of our problems lies in the difference in our organizational structures and the requirement that a program's structure reflect that organization. If our software is cleverly arranged so that we can thread a structural tree with locally coded branching decisions there is no reason why the other virtues of structured design would not retain their value. A structured program may be structured to match a campus organization chart, but it won't necessarily match the organization chart of any other campus.

There are related problems associated with calendar reporting periods. A monthly report may pose many problems if that month includes the end of one academic term and the beginning of the next. We can build dated transaction files during editing passes before applying those transactions to update principal files. Thus we can provide reports and summaries for differing periods with threshold dates. Management can get information by quarter, month, or whatever, but when action is called for, the same information can be summarized to match periods of responsibility. (Payroll programmers appreciate this; everybody they deal with is on a different fiscal year.)

The importance of language standards is almost too obvious to mention. What isn't so obvious is how much of our administrative programming is in a job control language (for which there are no standards) rather than a compiler language. If we really want to share benefits, we must establish and enforce standards of program implementation that avoid operating system -- hence manufacturer -- dependence. Further, those standard elements we employ must be in common use (available at your local hardware store), not definitions (low volume, hard to find, and expensive). A manufacturer may encourage creative engineering, but the use of other than standard SAE nuts, bolts, and fittings is a luxury that can rarely be justified. There isn't much market for luxury in higher education today.

The points discussed may help us share benefits, but like the beauty of the architect's perspective of our new buildings, a lot may be lost in the cost squeeze that strips it down to the functional concrete slab we actually build. In one recent case, we produced a very elegant systems design, and "finished" with a very crude program. The most valuable material we could share with another institution would be the minutes of the countless meetings with a committee of users in which the hard choices of what to include and what to exclude were made.

I think that our cooperative development processes are finally beginning to provide some shared benefit, but in trying to identify the reasons I noted that our areas of greatest success were those furthest removed from the academic process. In particular, we have been relatively successful in developments for our business and accounting offices, less so in payroll, somewhat in admissions, and barely at all in student records. This I think reflects a degree of difference in the management styles of those administrative units. We tread lightly on the democratic realms of academic freedom, but authoritarian managers make sure we have precisely what our soft-spoken auditors with their check lists and crushing impacts are looking for just where they expected to find it the next time they come through.

In summary, we might abstract the following prescriptions from the issues discussed:

- Develop widely accepted data element standards
- Use the standards as developed with local suffixes as necessary
- Use standard languages rather than non-standard job control languages
- Use dated transaction files to provide reporting period flexibility
- Build organization structure and distribution codes into tables rather than program structure
- Focus system design on management information (top down) vs information management (bottom up)
- Document what you didn't do as well as what you did.

These simple but important elements are, I think, critical keys in determining whether or not shared developments will really lead to a significant sharing of benefits.

References

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EXPERIENCE WITH COST/BENEFIT ANALYSIS IN THE CONCEPTUAL DESIGN OF MANAGEMENT INFORMATION SYSTEMS

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Between 1971 and 1975 Indiana University utilized classical cost/benefit analysis techiniques to assist management committees in the evaluation and selection of alternative proposals regarding the design and development of large-scale MIS projects.

Although the techinique was properly utilized in a technical sense, it was abandoned at the recommendation of top management advisors. This paper addresses the reasons for this decision, as well as the general problems associated with the use of such techniques in the university environment.

ACKNOWLEDGEMENT

A large portion of the material used in this paper was extracted from reports prepared by Mr. Al Leduc and others who were members of the Systems Development Staff of Data Systems and Services.

Experience With Cost/Benefit Analysis In The Conceptual Design Of Management Information Systems

After extended study involving up to 400 people throughout the Indiana University System a decision was made to develop a Management Information System. (This study is documented in publications available through CAUSE.) A committee known as the MIS Steering Committee was formed to set priorities for development. Since the members were at the Vice-Chancellor level, they asked that cost/benefit analysis be completed for each project alternative to assist them in carrying out their responsibilities.

Some time was spent establishing the procedures and parameters used to collect this information. The user task force, with the help of technical personnel to summarize the data, was responsible for establishing the benefits to be realized from each alternative. The technical personnel determined costs from the developmental and operations' standpoints including user operations. This material was then reported to the Steering Committee.

Benefits

The determination of "benefits" from a system was largely the responsibility of users with the assistance of the technical representative to the task force. Since the task forces in the Student Information System area were largely operational-level personnel (faculty and representatives from peripheral areas lost interest early) the benefits touted for the systems were largely those that somehow improved the operational environment of Registrar and Admissions officers. Benefits to students and functional managers (deans, business managers, etc.) were secondary.

An elaborate system of weights were developed to rank the benefits and thus establish some priority for features that determined the alternative chosen.

The sub-committee for each project listed the benefits they felt should be derived from the development of a new system and then each member individually distributed 1000 points among these benefits. All members' point assignments were totaled for each benefit and divided by the number of members to arrive at the relative importance for each. (See Table I.) The Committee then reviewed each alternative solution and determined how well the benefit was met by assigning a point value up to the maximum for that benefit, i.e., "Encourage Matriculation" could receive up to 159 points. The responses to this procedure were again averaged and accumulated for each alternative. Benefits were defined as beyond the basic system "requirements." Requirements were those features which the system must have to be acceptable.

Attachment A is pages from the Admissions system document describing system requirements and pages from the benefits list.

Table I is the benefit summary sheet from the Admissions system.

Cost Considerations

During the Conceptual Stage of each project, a cost study was made, attempting to list costs anticipated in initiating, developing and operating the prospective new system. The cost study at the end of the Definition Stage, which we will discuss, represented an attempt to use the knowledge gained during this stage. With this more detailed picture of what the preliminary design of the new system contains, a more accurate reflection of three types of costs can be given.

Development Costs

Development costs are those costs which are directly attributable to the completion of the development phase of the new project. These costs include the time of the data processing professional staff in program analysis, programming, testing, documentation, system training and initial implementation. It includes all the effort necessary to convert system specifications into a system fully accepted for routine operational use. Under guidelines for the Indiana University Information System, these costs were not "new" funds: they were all planned program expenditures in various accounts, most notably Data Systems and Services.

Initiation Costs

Initiation costs are those one-time costs necessary to replace the old system with a new one. An example would be the cost of programming for conversion from an old file to a new one and the resultant cost of running that one-time-only conversion. These costs generally do not represent "new" money either, and are planned program expenditures. In a few cases capital equipment purchases, for example, for communications, might represent "new" money.

Operational Costs

Operational costs are what it takes to run the new system. Included in this are data processing costs; the cost of new equipment and phone lines; postage: user manpower needed to operate the system; support services (those services offered by other departments and/or agencies which are required to make a new system run - included are expenses incurred by physical plant in moving equipment and lease of temporary telephones and WATS lines); forms and any maintenance required by Data Systems and Services to implement programming or system changes, either to improve the new system or to correct errors in programming or systems analysis. Costs reflected the following inflation factors per annum:

equipment - none

lines - none

DP costs - 7%

support services - 7%

forms - 30%

maintenance - 7%

postage - 20%　　　　manpower - 7%

The high percentage applied to forms was due to the paper shortage experienced in 1974-75.

The operational costs associated with any new system deserve considerable emphasis, particularly in their comparison with current system operational costs. Cost comparisons are necessary to respond to the institution's need to examine the potential changes in budget allocations which can occur after the new system is adopted. In order to assess these changes, the first step has been to supply a programmatic budget for the new system. Since Indiana University does not operate on a programmatic budget basis, an understanding of exactly what a programmatic budget comparison represents is imperative before any action could be taken to effect budget changes.

For any given system, an operating costs breakdown for the first full year of implementation of the new system is prepared. Costs are compared in two general listings; a "present system" cost, which is the cost the University could expect if the present system were continued until the year in question, and a "proposed" or "new system" cost. Costs are listed under each campus which are clearly attributable to that campus. In practice this means that the only operating costs which do not get distributed to the campus level are central data processing costs and central services' program maintenance costs.

The operating costs compare expected expenditures in five general categories: manpower, terminals and equipment, forms, postage and support services.[1] Assumptions governing each category are as follows:

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[1] It should be noted that these categories represent a simplification of the complete cost of a University "program": since there is no computation or assessment of such secondary or indirect levels of expenditures as heat and electricity, physical space, etc.

Manpower: For any given campus, the "present system" total is the estimated expenditure if the present system is continued until the first year of new system implementation. It normally does not include any incremental increase in personnel to cover increased volume or complexity, but is essentially current manpower cost, increased by an inflation factor of 7% per annum. Manpower costs are presented in the sub-categories of "part-time and hourly," "full-time," and "full-time other." "Part-time and hourly" categories include those wages, overtime and hourly monies which are or will be used to operate the system. "Full-time" categories include that portion of time spent by non-academic, full-time University employees employed to work in the system. An example of a "full-time" worker is a payroll clerk working on payroll. The "full-time other" category is the portion of time of otherwise fully-employed University non-academic personnel who are or will be "borrowed" to work on the system. Examples of the latter are departmental secretaries who participate in the present mass registration in order to "help-out." In some cases, it may be appropriate to list part-time expenditures for "other" employees, for example, for overtime incurred as an indirect result of the system.

Terminals and equipment: New systems may have significant equipment costs. Included in this category are the costs of terminals, printers, control units, modems and lines.

Forms: Forms costs represented one of the most volatile areas in estimating future costs due to the paper market in 1974-75. The figures included in the "present" system represented the cost of currently-used forms on the given campus, with an inflation factor of 30% per annum used. In the present system, most forms costs are borne by

Bloomington campus. The "future" costs represented the best estimate for the new system.

Postage: Design criteria for new systems may predicate greater use of mail for activities. The "present" system figure represents the current volume of postage use, increased by 20% per annum due to inflation. The "future" costs are based both on higher volume when needed, as in the new registration system, and the expected higher per-piece mail rate.

Support Services: Support services are those services offered by other departments and/or agencies that are required to make the system run. These include "set-up" costs, "phones" and "other" categories. Set-up costs include physical facility arrangements, such as equipment moving. Phone service includes only those temporary telephones and WATS lines needed to operate the system itself. "Other" costs include special, off-site keypunching. All support services costs for the present system were based on the current expenditures increased by 7% per annum for inflation.

Tables II - V represent information from Systems using these factors.

Procedures used by the technical personnel in arriving at actual figures are as follows:

Developmental Costs

After the functional design is completed the analyst estimates the costs which can be directly attributable to the completion of the development phase of the project.

1. Manpower costs are defined as the number of man-hours required for the analysts and programmer to complete the development effort. The Cost

Estimating formula as developed by the Federal System Division of IBM is utilized. The total estimated man-hours are multiplied by the average analyst/programmer hourly rate to compute total manpower costs.

2. Contingency costs are computed as 10% of manpower costs. This estimate is to allow for unforeseen circumstances that might occur during the development phase.
3. Equipment costs include any hardware that is required solely for the use of analyst/programmers during the development phase. CRT terminals make up the bulk of this cost category.
4. Training costs include man-hours required by data processors and users in teaching and learning to use the new system. Again, an average hourly rate is multiplied by the estimated number of man-hours required for training.
5. Support Services costs are defined as operating costs incurred during the development of the system. This includes computer, keypunching, paper, etc., type costs. Rather than compute detailed costs, it is estimated that 25% of manpower costs will approximate total operating costs. This percentage is derived from several studies completed by corporations that detailed their actual costs after completion of system development efforts.
6. Materials cost consist of the cost of special forms acquired from vendors. These costs are normally quite small as most vendors supply sample forms required during the development phase.
7. Travel costs include transportation, room, board, etc., expenditures incurred by the data processors to go to the various campuses to collect information and to train the users to operate the new system.
8. Users costs are defined as the user man hours required to assist in design and to test the new system. An average hourly rate is multiplied

by the estimated man-hours to compute user costs.

Initiation Costs

Initiation costs are those one-time costs necessary to replace the old system with a new one. An example is the cost of development for a conversion from an old file to a new one and the resultant cost of running that one-time only conversion.

User Operating Costs

The analyst and the primary users work together to determine this cost.

1. Manpower costs are defined as the user man-hours required to perform the following system functions:
    a. Forms processing
    b. Data entry
    c. Error resolution
    d. Filing
    e. Data lookup
    f. Secretarial

    The total estimated man-hours are multiplied by average user hourly rates to compute manpower costs.
2. Equipment costs include terminals, modems, communication lines and any other equipment to be installed and used in the user offices. File cabinets and microfiche readers are also included.
3. Postage costs are based on projected mailings required.
4. Support Services costs include telephones, setup of physical facilities for system functions: e.g., field house registration each semester, and costs incurred in Xeroxing. Fixed costs incurred regardless of the system chosen are not included: e.g., utilities, buildings, etc.
5. Material costs include the cost of special forms required.

Data Processing Operating Costs

1. Computer related costs are computed by using a formula developed within the department. The following units must be estimated for each program developed:
   a. Number of I/O accesses
   b. Lines of print
   c. C.P.U. time
   d. Microfiche
   e. Keypunching
   f. Cards read/punched

A predetermined rate has been calculated that when multiplied times the above units will compute the approximate actual costs of all hardware, software, personnel and overhead costs incurred within the Data Systems department. Each year this formula is reviewed and modified in order to keep current.

2. Programming maintenance costs are estimated to be 30% of man-hours required to develop the system (refer to manpower costs under Development Costs category). This percentage was derived from various articles published in data processing journals.
3. Equipment costs include special equipment for specific user systems. Normally communication costs at the central data processing site constitute most of this cost -- lines, modems, control units, etc., required to support user CRT terminals.

Cost Summary

Although the cost study performed proved invaluable as to informing the user community as to the cost of data processing services, several disadvantages also resulted:

1. The cost/benefit of doing a detailed cost study was not cost/beneficial

because of the enormous costs incurred to complete the study.

2. The cost estimating was done in too much detail as the detailed design had not been completed and eventually proved to be highly inaccurate due to many system changes that occurred during detailed design.

How much of any prospective savings can actually be realized? This question has always been a rather complicated one. Any proposed savings is actually potential which has varying levels of probability of realization depending upon the vigor and effort which goes into budget officer's budget negotiations for future fiscal years. The following guides were given for consideration: (See Table VI and VII)

1. There are "soft" costs within the cost savings figure whose reallocation will be difficult to realize. Such "soft" costs are most easily identified within each campus as the "full-time other" categories. Full recovery of the difference between "present system" costs and "future system" costs in this subcategory alone meant a savings of $101,630 for the new registration system.[2] To recover this cost or any portion of it means to exert some effort upon many different budgets -- the department manager who loans his secretary for mass registration for four days needs to be encouraged to reduce his budget by a dollar amount equivalent to the "freed time" that his secretary will have under the new system.
2. There are "hard" costs within the cost savings figure which must not reappear in a new system budget. It seems clear that the difference between the 1974-75 part-time and hourly program cost and the future part-time and

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[2] What this meant to the University was that this amount of labor was freed on a very de-centralized basis for work that was either not being done at that time or need not ever be done.

hourly program cost should be the reduction in the corresponding budgets between the present and the future, provided that no other "program" of the affected offices must increase. As an example, the Indianapolis Campus registrar's part-time and hourly budget attributable to registration in 1974-75 was $34,418. In 1976-77 with the new system, it was estimated to be $14,600. That budget change would have to be effected in order to realize "hard" cost savings. It must be clear that even to effect "hard" cost savings, a significant and unprecedented budgetary examination needs to be made in future fiscal years.

3. The net savings, in a time of hard-to-get new monies, result from significant cost exchanges. In brief, the issue at most campuses was how to exchange current manpower costs for future equipment costs. Since this may mean decreasing one account manager's budget to increase another's, some commitment to this principle was needed from top University management. Otherwise, there was some danger that the cost of a new system would be reckoned as mostly "new money" for equipment. This issue is complicated further by the fact that some campuses have fewer opportunities to reduce manpower costs than do others. In those cases it might have been appropriate to adjust the central University services charge accordingly. This charge is a percent of each campus budget assessed to fund these services.
4. There would have to be some absorption of transition costs. In addition to the initiation costs, which were mostly a special kind of one-time development cost and had been considered as planned program expenditures, there might be some costs necessitated by parallel operation of the old and new systems for operational checkout purposes. If such costs were to turn up some form of central services funding would be needed.
5. Some of the costs listed were recognized as extrapolations and estimates

and not agreed to by all applicable account managers. This fact should temper the literal interpretation of all figures as being absolutely allocatable costs. As with any operation involving many of the University's personnel, the accuracy of costs varies directly with the interest and accountability any given budget unit has for that operation's costs. In particular, "full-time other" costs cannot be re-categorized into smaller budget units, but the totals do represent a considered estimate of the total of such effort.

6. Consideration of the Student Information System as a total entity may alter budget recommendations. It may well be that the only way of determining the total cost impact, for example, of a new registration system was to view it simultaneously with all other prospective student information systems (or, perhaps IUMIS) projects. There really was no way of accurately looking at only one program budget without also comparing other interrelated ones. For instance, 1/5 of a departmental recorder's time might be freed by the new Registration System and 4/5 by the new Records Maintenance System resulting in one FTE salary savings.

7. Cost re-allocation has many possible pragmatic results. From a practical standpoint, it seemed that the situation of cost re-allocation had three possible solutions:

   a. The University and all sub-units of it might be willing to absorb all increased costs without attempting either to investigate or to impose any form of cost re-allocation.

   b. The University could insist that all units which benefit from the new system, including those which free previously locked resources, should be willing to pay for the new system with correspondingly changed budgets.

   c. The University could re-allocate certain costs and accept new costs up to some limit.

What Happened:

1. User Task Forces built the benefits to emphasize the alternative they wished to have developed. Since many of the benfits are intangible, i.e., "better service to students" "more responsiveness to faculty" the real value was hard to evaluate.
2. Cost estimates on projects were based on the end of the definition phase which was not in sufficient detail to solidify costs.
3. Though change controls were in effect for changes in specifications, no requirement was set for the cost/benefit analysis to be updated and reviewed by the MIS Steering Committee.
4. No agreement was ever reached on the actual shifting of resources from areas that would save money to those that would incur additional expenses. These changes of funding crossed accounting and organizational lines and there seemed to be no institutional committment to direct the redistribution of resources.
5. No mechanism was established to review or monitor costs during development, nor has there been any effort to identify changing cost patterns with the implementation of the system in the user's area.

Conclusion:

Though the effort expended did not result in actual redistribution of resources, some funds were set aside at year end to assist units that experienced new costs, but only during the initiation of the project.

The unit must absorb the additional cost, except for modems and communications lines which are funded from a central account.

The exercise did identify the cost of doing business whether under the existing system or some new system to be developed, which in itself was revealing to the University Administration.

ATTACHMENT A

SYSTEM REQUIREMENTS

I. Service

A. The system must provide for the collection and maintenance of student, institution and business "contact" files. These files are used to generate mailing labels and lists for dissemination of information to students, high schools and other external agencies.

B. The system must service the information requirements of the admissions operation as well as other university offices which utilize data collected by the admissions operation.

C. The system must provide feedback to the applicant on the status of his application.

II. Administrative Efficiency and Effectiveness

A. The system must accommodate the diverse needs of the admissions operation, including graduate, undergraduate, professional and non-degree admissions. This enables units with special information requirements, differential admissions criteria, or special operational constraints imposed by their constitutencies, to function under one system while satisfying their individual needs, by providing such optional special feature modules as "automatic" admission and missing information letters.

B. The system must assign responsibility for, and control of, data integrity to each admissions operation. Application, transfer, and special credit data preparation, entry, audit and correction procedures must be performed in the admissions operation.

C. The system must minimize redundant data collection.

D. The system must perform editing for validity and completeness of data at the time of entry.

E. The system must accept biographical and quantitative student data from a variety of sources, including American College Testing and College Entrance Examination Board.

F. The system must include an application fee processing procedure.

G. The system must support multiple school, college and campus admissions.

H. The system must meet predetermined levels of performance and reliability which will be determined in the Definition Phase.

I. The system must provide an alternate or backup method of data entry.

J. The system must permit future modifications or additions to the data base and operating procedures.

K. The system must accommodate progressive admissions, such as from nondegree to degree and from undergraduate to graduate or professional.

III. Information

A. The system must provide data for local campus and system-wide analytical and longitudinal studies.

B. The system must accommodate the data requirements specified by other MIS projects.

C. The system must provide activity and transaction statistics both at the admissions operation level and system-wide. These reports provide the means for auditing adherence to university policy, internal monitoring of operational activity, or identification of potential problem areas.

COMPARISON OF BENEFITS

CURRENT VS. RECOMMENDED SYSTEM

Points

159 1. The system should encourage matriculation of qualified, admitted students by providing a mechanism for distributing follow-up information to accepted applicants, such as information pertaining to academic advising, registration, orientation, financial aid, housing, health center and student activities.

Current: Current procedures for distributing follow-up are based on student requests for information, computerized notification for offices of students admitted, and other local office files. As a result, there is duplication of effort and unnecessary cost involved in repeated contact with the student.

Recommended: The recommended system will provide a single base for initiating contact with students and will keep records of contacts made and of requests for services made by the student. For example, the system can ask the student if he wants residence hall information, provide a mailing label in response to an affirmative answer and thus eliminate distributing this information with every admission application. The system will also establish a way in which the Admissions Office can have continuing contact with the student and thus encourage his matriculation.

156 2. The system should enable the admissions operation to service prospective students, university offices, high schools and other external agencies. Such services would include providing information on a timely basis, as well as prompt acknowledgement of, and response to, communications.

Current: The current system provides limited service to external publics by providing some feedback to the student and some reports for high schools and university administrators. Additional services provided are primarily manual operations.

Recommended: The recommended system will improve the services available to external publics by increasing the number and utility of reports and by automating some presently manual operations. For example, the new system will produce reports of transfer credit granted that are ready to mail to the student replacing the current manual preparation of this information.

150 3. The system should provide prompt feedback to applicants.

Current: The current system provides varying degrees of promptness of feedback in that delays are often encountered due to delays in data preparation and computer processing of applications. Other feedback is delayed due to difficulties in preparing mailing labels for selected groups of students.

TABLE I

SYSTEM ALTERNATIVES BENEFIT SUMMARY

BENEFIT	100%	CRT-INTERACTIVE		CRT-BATCH		CURRENT	
		%	POINTS	%	POINTS	%	POINTS
1. ENCOURAGE MATRICULATION	159	90%	143	80%	127	60%	95
2. PROMOTE SERVICE	156	90%	140	75%	117	50%	78
3. PROMPT FEEDBACK	150	95%	143	75%	113	45%	68
4. MINIMIZE INCONVENIENCE	146	85%	124	75%	110	20%	29
5. DATA MANAGEMENT	110	95%	105	70%	77	40%	44
6. EFFICIENCY	106	95%	101	70%	74	50%	53
7. ACCESS TO DATA BASE	96	95%	91	75%	72	50%	48
8. OTHER MIS PROJECTS	77	95%	73	70%	54	20%	15
TOTAL BENEFIT RATING	1,000		920		744		430

TABLE II

OPERATING COST

CRT-INTERACTIVE PROPOSAL

CAMPUS: ALL CAMPUSES

PROJECT: ADMISSION

COST CATEGORY	SYSTEM INITIATION	1975-76	1976-77	1977-78
1. USER OPERATING	52,692	441,528	466,577	493,297
2. DP OPERATING	2,310	49,688	49,688	49,688
3. OTHER				
TOTALS	55,002	491,216	516,265	542,985

USER OPERATING COST ANALYSIS
(Undergraduate and Graduate)

COST CATEGORY	SYSTEM INITIATION	1975-76	1976-77	1977-78
1. MANPOWER	8,192	333,692	350,376	367,894
2. EQUIPMENT	4,500	24,192	24,192	24,192
3. POSTAGE	-N/A-	33,595	36,955	40,651
4. SUPPORT SERVICES	5,000	-N/A-	-N/A-	-N/A-
5. MATERIAL	35,000	50,049	55,054	60,560
6. OTHER				
TOTALS	52,692	441,528	466,577	493,297

TABLE III

DEVELOPMENT COST

CRT-INTERACTIVE ALTERNATIVE

ALTERNATIVE: CRT-Interactive	PROJECT NAME: Admissions
PREPARED BY: Virgil White	DATE: September 9, 1974

COST CATEGORY	COST
1. MANPOWER	$ 67,753
2. CONTINGENCY 10 %	6,775
3. EQUIPMENT	1,122
4. TRAINING	9,500
5. SUPPORT SERVICES (25% of Manpower)	16,938
6. MATERIALS	100
7. TRAVEL AND LIVING	1,301
8. USER	6,500
TOTAL	$109,989

TABLE IV

SUMMARY COST COMPARISON TABLE

Alternative System	Development Cost	Initiation Cost	1975-76	1976-77	1977-78	Total Operating Cost	Total Cost
CRT-Interactive	$ 109,989	$ 55,002	$ 491,216	$ 516,265	$ 542,985	$ 1,550,466	$1,715,457
CRT-Batch	$ 97,685	$ 49,547	$ 504,303	$ 530,710	$ 558,838	$ 1,593,851	$1,741,083
Current			$ 499,053	$ 526,429	$ 555,593	$ 1,581,075	$1,581,075

TABLE V

COST/BENEFIT ANALYSIS

ALTERNATIVE	COST/BENEFIT RATIO *
CRT-Interactive	1865
CRT-Batch	2340
Current	3677

* The lowest score is the most favorable. The figure is derived by dividing the cost of each alternative by its benefits score.

TABLE VI

TOTAL SYSTEM COST
REGISTRATION SYSTEM

	Present	Future '76-77	Difference
Manpower: Grand Total	617,270	387,880	-229,390
Part-time and hourly, Registrar	123,930	93,530	- 30,400
Part-time and hourly, non-Registrar	115,680	79,960	- 35,720
Full-time, Registrar	143,120	87,110	- 56,010
Full-time, non-Registrar: total	234,540	127,280	-107,260
Full-time Bursar	99,020	93,390	- 5,630
Full-time other	135,520	33,890	-101,630
Equipment	130	231,790	+231,660
-Modems	0	21,940	+ 21,940
-Lines	0	12,630	+ 12,630
-Terminals	0	197,220	+197,220
Forms	85,560	65,240	- 20,320
Postage	26,830	54,810	+ 27,980
Support Services: Grand Total	58,570	34,160	- 24,410
Set-up	15,650	16,300	+ 650
Phones	13,060	17,860	+ 4,800
Other	29,860	-0-	- 29,860
Central System Costs	105,140	145,790	+ 40,650
Data Processing Operations	90,210	126,490	+ 36,280
Program Maintenance	14,930	19,300	+ 4,370
TOTAL OPERATING COSTS	893,500	919,670	+26,170

TABLE VII
INDIANA UNIVERSITY/PURDUE UNIVERSITY AT INDIANAPOLIS
REGISTRATION SYSTEM

	Present	Future '76-77	Difference
Manpower: Grand Total	186,650	103,970	-82,680
Part-time and hourly, Registrar	41,990	14,600	-27,390
Part-time and hourly, non-Registrar	53,430	30,770	-22,660
Full-time, Registrar	36,920	17,820	-19,100
Full-time, non-Registrar: total	54,310	40,780	-13,530
Full-time Bursar	13,550	30,590	+17,040
Full-time other	40,760	10,190	-30,570
Equipment	-0-	45,700	+45,700
-Modems	-0-	2,140	+ 2,140
-Lines	-0-	1,690	+ 1,690
-Terminals	-0-	41,870	+41,870
Forms	700	15,320	+14,620
Postage	1,850	14,550	+12,700
Support Services: Grand Total	12,690	3,230	- 9,460
Set-up	3,410	1,500	- 1,910
Phones	4,100	1,730	- 2,370
Other	5,180	-0-	- 5,180
TOTAL:	201,890	182,770	-19,120

THE DEVELOPMENT OF A SMALL UNIVERSITY'S INFORMATION SYSTEM: A POTPOURRI OF PHILOSOPHY, PEOPLE, PASSION, PITFALLS, PROMISES AND PROCTOLOGY...or $(P)^7$

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The needs and problems of the small college or university management information system are highly similar to the large institution; however, the magnitude differs. Because of limited resources, a system may be even more important to the continued existence of the small institution. An optimum sized staff may include so few people that any personnel changes may create extreme problems. Finding affordable hardware and software for the academic and administrative needs, problems of fear, communications, passive and active resistance plague the systems development of the small institution. It appears that advancements in software and mini-computers offer significant hope for the future.

BACKGROUND

Welcome, to an autopsy. While this may be your first experience as a participant in the post-mortem examination of any type, you may find the results of some value or at least interesting. Much has been learned in the field of medical science from the inspection and dissection of a body after death, as to the determination of the cause of death and it is my premise that the same may be true in the field of data processing and university information systems.

Preliminary, gross examination reveals a seventy-five year old, indepedent university of approximately 1500 students located in the central Midwest. Although the local community is based on an agrarian economy (primarily corn and soy beans - "succotash") the institution is situated in a city of approximately 100,000 population that is heavily industrialized. The institution is not particularly unique among its peer group of other independent institutions of its size. It does have two professional schools (1) Music and (2) Business and Industrial Management in addition to its traditional College of Arts and Sciences. Its history has been somewhat marked by various points of recognition in the importance of and appreciation for the vocational and technical (e.g., industrial engineering, welding engineering, etc.) aspects of higher education. This particular tenor of the curricular structure was determined by the founder who was a local successful businessman, turned philanthropist who originally came to the area as a sheep herder from Pennsylvania. Throughout the institution's history it has tended to follow national trends of other similar organizations in higher education. Many systematic features including such items as physical plant, enrollments in recent years, endowment quality of education, alumni giving, etc., has tended to indicate an above average state of institutional health. There is some symptomatic indication however, of inability to overcome 75 years of inertia and perhaps "arthritis of the brain."

Although the initial inoculation (or "infection?") of Electronic Data Processing can be traced back fifteen years ago (i.e., 28 March 63) with an IBM 1620, the entire concept has met with very limited success. Further systematic diagnosis indicates that fear on the part of some employees in key positions of losing their jobs, tended to negate the effectiveness of the introduction process. The University stayed on manual operations. In retrospect it can also be said that the individual attempting the introduction was quite naive in the area of campus politics.

Further attempts were about equally as successful (abortive?) and resulted in the purchase of some desk calculators and some minor use of time-sharing terminals (i.e., two) with a local industry's computer.

Development remained virtually at a standstill until the fall of 1972 with the return of a senior faculty member from academic leave. This individual (who held the rank of Professor in Industrial Engineering) had elected to leave the field of engineering and industrial management and return to the University of Illinois for a doctorate with an emphasis on Administration in Higher Education and had served an internship in the Administrative Data Center of that institution. Upon returning to the sponsoring institution, this individual (who on occasion referred to himself as a "recently retarded retread") was given the administrative assignment of institutional research at the vice presidential level. The four major functions of the office were administration of the university-wide evaluation system, long range planning, the usual institutional studies (e.g., HEGIS and various internal investigations on enrollments, etc.) and coordination of computer activities (both academic and administrative). It is interesting at this point in our post-mortem examination that we can already detect at least two symptomatic indications of problems ahead. First, we have an individual that moved to a different environment, became exposed to a new set of ideas, concepts, techniques, and people. Upon return to the former environment the individual had changed; however, the institution had not. Second, as stated in *Computers On Campus*, "the director needs the political neutrality he can get only by reporting to the office of the president" (Coffrey and Mosmann, 1967, p. 114). In this case it was the designated responsibility of a second level (vice presidential) position, thus lacking the implied positional authority of the office of the president and the publicly proclaimed commitment on the part of the chief executive.

AN APPROACH-METHODOLOGY

"As we all know, times have changed, and our planning perspective has also changed from one focusing on growth to managing our institutional resources, where they are either static, growing very slightly, or declining. The demands upon us now are to achieve change and vitality in a no-growth situation by making optimum use of our resources in support of our academic program. We now need information that can help us to manage resources by carefully integrating our academic policy objectives with allocation of funds" (McCorkle, 1977,p.2).

What I am presenting here is the anatomy of a design. The implementation of a small University's information system, replete with all the successes and failures. A case study (please see Figure 1). The approach utilized is a concept, somewhat of a philosophy, encompasssing two proven techniques, namely Participative Management (MP), and a systems analysis approach based on a modification of the Program Evaluation and Review Technique (PERT, please see Figure 2). It might also be considered as a schematic of a feasibility study. While it was readily recognized as not being a universal panacea, it was felt that

FIGURE 1

THE MAJOR THRUST OF THE STUDY WAS BASED ON THE CONCEPT OF PARTICIPATIVE MANAGEMENT, WHEREIN INVOLVEMENT TENDS TO ENHANCE DECISION-QUALITY, ACCEPTANCE, COMMUNICATIONS, AND PROVIDE AN EDUCATIONAL EXPERIENCE FOR PARTICIPANTS (PARTICULARLY FOR STUDENTS).

* * *

FIGURE 2

PROGRAM EVALUATION AND REVIEW TECHNIQUE (PERT)

A MODIFICATION OF THE PERT CONCEPT WITH PRIMARY EMPHASIS ON THE FOLLOWING FEATURES:

- THREE LEVELS OF ESTIMATES
- SYSTEMS APPROACH IN ATTEMPTING TO RECOGNIZE ALL SIGNIFICANT FACTORS

such a concept was worthy of consideration for several reasons. First, it enhances communication. Once decisions are made, all those involved know how they were made. Second, acceptance tends to be increased. Since decisions will undoubtedly result in a compromise between all the individuals that have had input, there is a greater probability of general acceptance and hence support than if the decisions were mandated from a superordinate or higher level. A third, major advantage is that the quality of decisions tends to be improved. With input from all areas affected there is a greater probability of meeting all the various and diverse needs of the constituence. It was recognized that there is no technique that is without some degree of inadequacy and it was anticipated that there would be two areas and possibly a third that might cause problems. First, the concept of participative management requires that the people affected by the decisions want to be involved in the decision making process. Second, the process tends to be time consuming, and all the committee meetings may be offensive to some. Third, the decisions must have the complete (and publicly stated) support and commitment of the chief executive of the organization as well as subordinates and prospective users.

Now, for a brief review of techniques (please see Figure 3). From this point of view, participative management is used in the context of all those that are affected by a decision, have an opportunity for input. In an educational institution it may (and I feel it should) also include student input. This can provide another opportunity of extending the educational process beyond the confines of the classroom. Participative management (as used here) still recognizes that essentially; (a) groups advise, (b) individuals decide and then are accountable, (c) it does not mean that the decision maker abdicates authority, responsibility, or accountability.

The modified PERT system as presented here emphasizes two main features.

FIGURE 3

PARTICIPATIVE MANAGEMENT STILL RECOGNIZES THAT ESSENTIALLY:

- GROUPS ADVISE
- INDIVIDUALS DECIDE AND THEN ARE ACCOUNTABLE
- IT DOES NOT MEAN THAT THE DECISION MAKER ABDICATES AUTHORITY, RESPONSIBILITY, OR ACCOUNTABILITY.

The first is three levels of estimates i.e., normal, optimistic, and pessimistic. This allows the participant considerable leeway and a greater degree of comfort than insisting on a specific fixed quantified value. The modification also utilizes the systems approach in attempting to recognize all significant factors.

The systems approach contains three developmental stages (please see Figure 4) i.e., needs determination, means of meeting the organization needs, and finally the recommendations and/or proposal. The function of Needs Determination (please see Figure 5) is further based upon three elements i.e., operational analysis of the organization, the proposed uses of the system, and displaceable costs. The needs determination (please see Figure 6) utilizes the operational analysis to determine what of the organization's presently performed functions would be readily adaptable to EDP, and three levels of cost estimates based on the PERT concept. As each participant lists his data processing needs, each is asked to make three estimates of what the costs would be in processing the information: a normal estimate, or an estimate which would be the normally expected or most likely cost for processing the data; an optimistic estimate, or conservative estimate representing the least possible cost for processing and a pessimistic estimate which might be the most it could possibly cost to perform the processing functions under the most adverse conditions.

Also under the Needs Determination phase proposed uses are explored,(please see Figure 7) based on the premise of the availability of an adequate system and again three levels of value estimates are made (i.e., normal, optimistic, and pessimistic). These estimates might be considered as positive values, or the dollar estimates of what the proposed uses would be worth to the organization. It is "pie-in-the-sky" and hence the values are not included in the final figure. Each participant is asked to give an estimate of the dollar value for

FIGURE 4

THREE DEVELOPMENTAL STAGES

(INTERNAL)

I. NEEDS DETERMINATION

II. MEANS OF MEETING ORGANIZATIONAL NEEDS

III. RECOMMENDATIONS AND/OR PROPOSAL

* * *

FIGURE 5

I. NEEDS DETERMINATION

1. OPERATIONAL ANALYSIS
2. PROPOSED USES
3. DISPLACEABLE COSTS

* * *

FIGURE 6

I. NEEDS DETERMINATION

1. OPERATIONAL ANALYSIS

   -PRESENTLY PERFORMED FUNCTIONS (READILY ADAPTABLE TO EDP) AND THREE LEVELS OF COST ESTIMATES BASED ON THE PERT CONCEPT.

2. ______________________
3. ______________________

FIGURE 7

I. NEEDS DETERMINATION

1. ______________________________

2. PROPOSED USES

   - IF SUCH A FACILITY WERE AVAILABLE WHAT SERVICES WOULD IT PROVIDE AND THREE LEVELS OF VALUE ESTIMATES (E.G., NORMAL, OPTIMISTIC, AND PESSIMISTIC).

3. ______________________________

being able to perform the proposed functions. First, based upon the normally expected conditions; then the greatest or most optimistic value; and finally the least possible value (or pessimistic estimate). The final phase of the Needs Determination considers displaceable costs (please see Figure 8); that is, costs presently being incurred for data services that would be provided by the proposed facility. These are actual costs, based on records and not estimates. By using a conservative approach of the sum of the optimistic estimates (i.e., the total of the least possible estimated costs of performing the presently performed functions by EDP) of the currently performed functions, plus the displaceable costs, a safe and usable dollar figure may be determined and used as a basis for comparison. This may be used in determining how much money you may wish to allocate for EDP. The sum of the estimated values (pessimistic in this case since they are considered as positive values) of the proposed uses provide an additional margin of safety---especially since they are not added to the base figure. This may be expressed as a simple formula as follows:

> SUM OF OPTIMISTIC ESTIMATES (LOWEST) COSTS OF PERFORMING CURRENTLY PERFORMED FUNCTIONS + SUM OF DISPLACEABLE COSTS = BASE FIGURE.
>
> The sum of the estimated values of proposed uses are considered aside from the base figure.

The second major element is to explore all (as nearly as feasible) various means of meeting the organization's needs as previously established (please see Figure 9). Such an investigation would consider such methods as time-sharing, service bureaus, an in-house facility, and continued manual operation, etc. The investigation may be conducted simultaneously by the coordinator and members of the committee which may be composed of students, faculty and administrators, if applicable. It is desirable that all members of the campus community be con-

FIGURE 8

I. NEEDS DETERMINATION

1. ______________________

2. ______________________

3. DISPLACEABLE COSTS

   - COSTS NOW INCURRED FOR DATA SERVICES, THAT WOULD BE PROVIDED BY THE PROPOSED FACILITY.

* * *

FIGURE 9

II. MEANS OF MEETING ORGANIZATIONAL NEEDS

- INVESTIGATION OF VARIOUS MEANS OF MEETING ORGANIZATIONAL NEEDS (E.G., TIME-SHARING, SERVICE BUREAU, IN HOUSE FACILITY, CONTINUED MANUAL OPERATIONS, ETC.). INVESTIGATION CONDUCTED SIMULTANEOUSLY BY THE COORDINATOR AND THE STUDENT-FACULTY-ADMINISTRATIVE COMMITTEE. ALL MEMBERS OF THE CAMPUS COMMUNITY CONTACTED FOR INPUT (RELATIVE TO ITEMS IN SECTION I.) BY REPRESENTATIVES OF THE ADVISORY COMMITTEE.

tacted for input. This tends to allow improved communication, acceptance and allow for subtle education in many cases.

The final stage is the recommendations and/or proposal (please see Figure 10). This is the final document summarizing the background, findings, proposal, and the recommendations directed to the final decision maker or makers such as the president and/or the board.

INITIAL OUTCOME

Following the approach just outlined and based on the findings of the users' advisory committee that was composed of students, faculty, and administration, an in-house facility was established. A centrally located room was remodeled, an NCR Century 101 (32K, 300lpm printer, 300cpm card reader, 20 Megabytes on disk) was leased. A director was hired and after extensive testing and interviews, two members of the secretarial staff were transferred to the department as programmer-trainees and the project was launched. The first project was conversion of the payroll, followed by student records, financial aid, and student evaluation of instruction. Progress seemed well above average for over a year.

THINGS STARTED FALLING APART

The initial premise was that a carefully planned progression be made starting with minimal budget and staff, then as utilization increased this need would be met with the allocation of additional resources. In actuality, however, the desire for a balanced institutional budget precluded any further resource allocation. The staff became greatly overworked. Committee members became disenchanted with committee meetings; therefore attendance and the number of meetings declined. Also the user committee was never granted the requested

FIGURE 10

III. RECOMMENDATIONS AND/OR PROPOSAL

- THE FINAL DOCUMENT, SUMMARIZING THE BACKGROUND, FINDINGS, PROPOSALS, AND RECOMMENDATIONS AND DIRECTED TO THE DECISION-MAKER(S) (I.E., PRESIDENT AND/OR BOARD).

status of a university standing committee. With the influx of a number of new, young, faculty members that were sophisticated in the field of electronic data processing, student utilization soared. At one time it rose to an all time high of over 140% (CPU utilization based on a normal eight hour working day) with a great amount of overtime. All facilities became greatly overworked. The small data center (i.e., less than 700 ft^2) became highly overcrowded. Programming environment degraded until production was very low. Then the director suffered a very serious accident and was hospitalized for a considerable time. Conditions steadily worsened.

WHAT WENT WRONG

These conditions plus, "...my own diagnosis is that we have not used information very well, and that we will have to re-examine our use of it if we are going to be able to integrate resource allocation with our academic planning. I suspect that we have used information poorly for a number of reasons." (McCorkle, 1977, p 5). "Data become informative only when we have specific policy questions that need illumination and resolution. The kind of policy question that is asked dictates information requirements. Management information takes many forms, including both quantified data and subjective judgments of informed persons. Our systems are so complex and our educational objectives so multi-dimensional that we cannot rely on any single variety of information source" (McCorkle, 1977, p 3). "Part of the problem with getting useful information is that we have not made the necessary top management decisions to govern the type of information to be assembled and how it should be used" (McCorkle, 1977, p 7). "What we should be doing, and have not done enough of, is to define our major policy problems, often relying on data as part of the information used, articulating a series of different strategies for dealing with them, and *then* looking for information that will help in evaluating these different strategies. We can and should continue to use data to help us pinpoint management issues and define our specific policy needs, but we cannot expect these data by themselves to articulate management options and point out our choices"[8] (McCorkle, 1977, p 7).

WHERE WE ARE NOW

The University information system is now in limbo. All data processing personnel have gone on to other employment. The data center is now closed. The institution has returned to nearly total manual operations (i.e., payroll is being run on another institution's computer). With the return to the "quill pen and inkwell" status, the computer is still being used on a limited basis by some of the faculty. No decision has been made to date. An advisory committee, headed by the chief executive of the institution, has been activated to study the situation. Also, there is a time-sharing terminal on loan from a local industry that is being used on a very limited basis in a few academic areas. It appears there is nearly total disenchantment with the entire concept. The responsibility for the data processing function has now been shifted to the president.

The entire field of information systems and data processing is an extremely volatile one and many rapid advancements are being made in software and minicomputers. Each passing day ushers in new, but much more easily operable systems that are readily adaptable to the needs of the small institution. It appears that many of these are not only reasonable in cost, but high in capability, and relatively easy to implement. Such a "turn-key" system may provide a relatively safe and viable choice to small colleges and universities.

WHAT WE HAVE LEARNED

I agree with Weathersby that it appears that actual planning and decision-making is far more politically based and intuitive than many top-ranking administrators might care to publicly admit (Weathersby, 1976).

"We have also learned that the contributions of information systems are limited by our own ability to carefully think through what kinds of decisions we need to make on what kinds of issues. Although we sometimes might like to think otherwise, the information we use to analyze our academic programs is *subjective* reflecting the opinions and biases of the individuals who gathered and analyzed the data" (McCorkle, 1977, p 4). In short, we have learned that information systems are not a panacea. They are necessary, even vital to the continued existence of higher education. Whether we like it or not we are in an era of increasing accountability to all of our higher educational constituents. The benefits of higher education have been oversold and the general populace is exhibiting an increasing degree of disenchangment; therefore, it is becoming increasingly important that we can demonstrate to our constituencies and ourselves that we can and are making sound decisions based on the best use of information available to manage our institutional resources. All this points to increased need for good information systems.

"The successful development of information systems should not be viewed only as a technical problem." (Schmidtlein, 1977, p 41). Anyone concerned with developing information systems knows, of course, that the creation of a system is frustrated far more often by political concerns than by problems of technical feasibility (Schmidtlein, 1977, p 29). In the final analysis, success appears highly dependent on people and change. Things are built around people and people have personalities. Change in the field of higher education may be keyed to three forces as Bacchetti has stated. The first force he has identified is the gradual decline in the ability to examine, express, and on occasion modify institutional purposes. I also agree with his concept of the other two forces. The others are far-reaching financial limitations and increased appreciation for sophisticated management (Bacchetti, 1977). The first two tend to negate the positive effects of the third but at least it does offer some ray of hope.

Many people seem to prefer the pain and discomfort of a "known" bad situation, rather than the fear of the "unknown," that may lead to a vastly improved situation. Fear may bring about procrastination in the decision making process, and experience tells us that procrastination is the most insidious form of denial. When we refuse to make a decision we have, in effect, made one. Once this happens, then management or administration loses its leadership role and becomes reactionary to the environmental pressures. We must not underestimate the element of fear. Surprisingly, fear is found in the most unexpected places and to an unexpected degree. It can bring about insidious failure and "to insure the continued success of the data processing installation in meeting organizational needs, it is not sufficient to use participative management in needs assessment and installation choice, and then stop. The continued involvement of each level of organizational hierarchy in the continuing evaluation of the system is essential. Without continued involvement by staff, (through the avenue of a user's committee, for example), it is probable that the installation will lose the crucial support of its users and be perceived as not adequately meeting their needs." (Glasscock & McKeown, 1976, p 120).

Continuing with the proctological examination it may be beneficial to briefly outline the total post-mortum results.

> We all resist change to some degree and fear of the unknown (e.g., information systems data processing and a computer) is a barrier of major magnitude when it comes to change within an institution of higher education.
>
> Even in a small institution, participative management, committee involvement, and other democratic processes may not be adequate to the task of dispelling fear.
>
> Having the support of the faculty and students is not enough..
>
> The publicly stated support by the chief executive is necessary.
>
> A firm commitment of resources, conversion schedules and a stated attitude of cooperation must be required by the chief executive.
>
> The positional authority (and demonstrated commitment) of having the system directly responsible to the office of the chief executive is desirable.
>
> Individuals may change---institutions may not. Once an individual leaves an environment and becomes exposed to new concepts and ideas and then returns to the former environment that is essentially unchanged, the individual becomes highly suspect, and meets great opposition to change and develops a high level of anxiety and frustration in attempting to bring about change in the institution.
>
> Selecting and promoting from within may create status problems within staff personnel, thereby enhancing uncooperative attitudes. Many jobs (e.g., keypunch) have implied status in the minds of some people.
>
> Things are built around people and people have personalities.
>
> Fear of any type (e.g., loss of employment, change, learning something new, the unknown) is very difficult to overcome.
>
> To be successful a system must have the commited support of all levels (i.e., students, faculty, president, and the staff). Lack of support in any of the groups can spell disaster.
>
> Procrastination in the decision making process is the most insidious form of denial.
>
> Education (regardless of how subtle) may be necessary at all levels. This is especially true in the case of the chief executive, unless the individual is already knowledgeable in the field.

While an optimum sized staff (i.e., based on the minimum number of people) may appear quite efficient in terms of budget, it provides no reserve in case of an emergency (e.g., illness, personnel changes, etc.).

Passive resistance may effectively slow or even prevent systems development.

Minimal staff also makes professional training difficult and allows functional control to be exercised by an individual (e.g., program development, documentation, etc.) through systems dependency.

Because of limited resources the small institution's margin for error is less; however, operational efficiency is crucial and control is difficult. This may be true, in part, because of the propinquity of a small organization and the resulting communications that accompany the ability of information systems to detect "errors" and provide a system of checks and balances. Properly designed information systems tell the truth without discrimination.

Well, so much for the autopsy. While I agree with Adams, "...that we must conclude that the overall record of information system development in support of decision processes in higher education is not good," I still believe it is one of the hopes of the future --- if we can learn from our mistakes --- and successes. I believe that with finances tight in the field of education it behooves us to attempt to ensure that all our resources, human as well as financial and physical, are efficiently utilized so as to provide the richest academic environment for our students. The students are the focal point --- our real hope for the future. I believe this a fact of life and not a legislative mandate. So, if we are allowed the privilege of working with the future (i.e., through our students) what greater exciting and worthwhile challenge can there be.

If we can only maintain our sense of humor and not take ourselves too seriously, continue to learn from our mistakes and concentrate on providing the best possible academic environment for our students ... who knows, we may achieve some degree of success yet.

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AN INFORMATION SYSTEM
FOR THE SMALL COLLEGE

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This paper presents the underling philosophy of a college management information system. The topics discussed include the system rationale and development. The system architecture, file structures along with their key linkages are presented. Summarized cost justifications in graphic form are included.

PREFACE

Columbus Technical Institute Management Information System (C.T.I.M.I.S.) is the result of years of planning and development at Columbus Technical Institute, Columbus, Ohio. The system is the product of a committee process and individual efforts toward the improvement of management concepts for assistance in administrative and instructional decision-making at Columbus Technical Institute.

C.T.I.M.I.S. represents a master plan for the management of information of both a quantitative and a narrative nature. Data processing applications to management have had their greatest advance in quantitative information. The quantitative concept of C.T.I.M.I.S., encompasses numerical and statistical factors of institutional operations (e.g., enrollments, financial reports). The narrative concept relates to normative-traditional communications between administrative offices and is of the written word nature. Narrative portions of C.T.I.M.I.S. both supplement and complement the quantitative component. The narrative content of the C.T.I.M.I.S. is related primarily to documentation, procedural, and summarization statements necessary for administrative support functions. The data bases are characteristic of the college district which maintains a certain level of centralized decision-making.

Education has traditionally been organized into a number of functional areas (e.g., administration, instruction, student and personnel services) which are operationally autonomous of one another. These traditional functions have been construed as the subsystems within C.T.I.M.I.S. The functional independence of these functions pertains primarily to the records and communications of each subsystem data base. Administrative and supervisory organization components have followed similar breakdowns. It is feasible to continue this functional division in order that established data bases be operationally integrated. For example, the student services component has a series of records, applications, transactions and communications which are unique to that function (e.g., admissions, placement, student activities). There are also counselor and paraprofessional subcultures that are collectively known as the student personnel component of the organizagion.

The institution, whether college or university, is dependent on the total integration of all subsystems. Management looks to the aggregate results of all functions and must be aware of the influences each subsystem may bring to bear on other subsystems. The management information system approach provides a vehicle for integrating the more significant data from each of the subsystems for management processes. The total integration of a management information system means that common elements are treated in a like manner throughout the system and that interlinkage is possible between data records and files.

The larger and more complex the organization becomes, the more important it is to establish summary levels of information. C.T.I.M.I.S., at its present level of development, has its greatest impact upon the operational aspects of the campus district. As such, supporting data processing applications are an administrative service. However, further exploration is necessary into the areas of model simulation, planning and executive management predication models.

Design concepts include a centralized processing capability with record access for the campus operation. C.T.I.M.I.S. is a software product capable of adaptation to various IBM central processing units. Clearly, a wide range of management systems and techniques are available in education.

The computer objectives explored within C.T.I.M.I.S. are: (1) an operational system, (2) a planning system, and (3) an executive management system.

C.T.I.M.I.S. is an operational system in its productivity of communications and statistics normal to ongoing operations of a community college. It integrates a range of information-accounting reports, on-line enrollments, class rosters, grade reports, payroll and faculty class assignments as examples. C.T.I.M.I.S. maintains control over the integration of data bases, selective retrieval, computation, and print-programs.

C.T.I.M.I.S., however, is primarily a planning system wherein analytical study programs, report aggregations, historical comparisons, statistical projections, and computer simulation models are utilized.

The third and last objective (3) is a combination of the first two objectives and will vary according to demand and the administrative style of executive level administrators.

INTRODUCTION

Accountability in higher education is most frequently characterized by efficient utilization of available resources. Increasingly, decisions are based on systematically gathered data subjected to quantitative analysis. This approach to administration requires accurate, reliable information about an institution's fiscal and human resources, current operations, and future programs.

Accountability, in a greater sense, is the acceptance of responsibility for the productivity, communications, and end results of the education process. The practical problem is one of organization and proper administration to achieve a working complex of meaningful information. C.T.I.M.I.S. is an operational approach to combining information emanating from functional areas to aid in the administration of the entire organization or a "total integrated information system". "Total" suggests that all areas requiring control, evaluation, and decisions are continually dealt with.

C.T.I.M.I.S. is a dynamic, organized plan that services factual needs of all areas while providing information for effective administration of the institution. The total information system is a linked network of raw facts (data), processed data (information) and the manual and automated procedures which make the network operative. Management and data processing have historically cut across organizational lines. This fact will become even more pronounced in the operation of C.T.I.M.I.S. The result is a significant increase in the capacity to coordinate instructional, administrative, and support activities in higher education.

The major systems improvement is the elimination of the duplication of data, reduction of the number of times that data must be transmitted, and efficiency in compilation and display of information. Planned storage and processing of data requires a single entry and only one entry into the system. The concept of "integration" provides the ability to cross reference, interrelate, and retrieve all data within the entire system.

The C.T.I.M.I.S. network consists of major subsystems:

- Student
- Personnel
- Instruction
- Finance
- Facilities
- Research

These subsystems are the major components of higher education information systems. They are clearly receiving emphasis as "common ground" in the multitude of taxonomies being developed in educational systems.

WHAT IS AN INFORMATION SYSTEM?

Information systems are inherent in any organization of people. They may be planned and recognized as information systems, or they may be unplanned and unrecognized -- but they do exist in all organizations.

They exist out of the need for keeping people within an organization on their respective targets, whether the target is a reduction in cost, or an improvement in the end product. Their value is measured by their use.

Scope of an information system is dependent upon the degree and quality of planning that goes into it. It can be as broad as the vision of those who are to use it, but it must be based upon sound, realistic evaluations.

Costs of information systems, good and poor, are relatively large and rarely fully identified. It might be added that cost differences between good and poor information systems is relatively small except for the effort and disciplines that go into their planning.

An information system can be defined as that body of information which management finds advantageous or necessary to use in order to maximize effectiveness of its various programs, together with people, supplies, equipment, furniture, and services that make this information available.

The value of an information system is determined by its content and use. Its content is determined by the views of management and the experience and capability of those who guide its construction. Its use is determined by its content, its ready availability, and its format in all respects.

NEED FOR AN INFORMATION SYSTEM

It has been stated that schools exist for the purpose of preparing the youth of today for maximum capability of successful living in the environment of their later years. Each college operates with an objective, stated or implied, and has developed a series of educational programs each of which makes its contribution toward achievement of the college objectives. Each program has been evaluated for its relative effectiveness toward achievement of the college objective.

An information system is a program of a "staff" or supporting nature with the objective of increasing the effectiveness of "line" programs (such as instruction program) which in turn directly contribute to the college objectives. An information system must pass this same evaluation test of its relative contribution toward the effectiveness of line programs it supports. Its main use should be the effective dissemination of information.

Even the smallest colleges maintained a type of information system which may have consisted of little more than the teacher's grade book, telephone and mail service, and expense records. As educational systems increase in size, demands placed upon information systems increase. In a multi-campus college, opportunities multiply for the information system to improve the effectiveness of its main line programs. In fact, a college of today could not exist without an information system.

In education, an information system program is an essential tool, school tables can replace school desks, multi-purpose rooms can replace cafeterias, but nothing can replace an information system except a better one. Up to a point, the better the information system, the better the education per available dollar.

PURPOSE OF INFORMATION SYSTEM

The purpose of an information system is to enhance the effectiveness of an organization through the display of pertinent information. Most organizations have available a variety of programs competing for emphasis in their potential contribution toward the organization's objective. In colleges, bookbinding competes with purchase of new books, secretary additions compete with teacher additions, improved lighting and chalkboard standards compete with other programs. An information system is a similar program. It is because of an information system that decisions are made which enhance the effectiveness of other programs and hence of the total education process.

Counselors also exist for the purpose of enhancing effectiveness of the college, but they in turn must often depend upon the information system, and it is for this reason that they draw upon files and make varied analyses. Effectiveness of their counseling is many times affected by availability and ready availability through data display, of adequate information and analyses.

A school system itself is largely an information system where students obtain information and concepts and learn to use them properly. Since students are human beings and respond like human beings, the information and concepts must be presented professionally and must be conveyed to students by personnel with proper training and background. All that is told to students in class could be written once and read thereafter in books, but without professional presentation the education process would not be successful nor would it meet current needs. All information systems have in common this need for professional presentation both in operation and in the continuous process of their development.

Value of information is measured by the effectiveness of its use. Its use, as in the case of students, is determined largely by its presentation. It is for this reason that data processing has always applied meticulous care to the presentation of information, whether this entails the design of a straight, evenly printed line or of a page type on a display tube. Information must be conveyed to people, including students in the classroom, in such manner as they will use it if it is to effectively serve its purpose. It must be available where needed, when needed, and in a format designed to invite its use.

Information systems have the sole function of enhancing effectiveness of the programs they serve. They are effective only insofar as the information is used, whether in minor or in million dollar decisions. Information tends to be used only when pressures of its need outweigh inconvenience of obtaining it and reading it. The more easily obtainable and readable the information the more it will be used; and the more information is used the more valuable is the entire information system.

WHAT IS A COMPLETE TWO-YEAR COLLEGE INFORMATION SYSTEM?

Opportunities to improve education through improved information availability are probably as numerous as those available to improve business effectiveness by the same means. Both educators and the public appear generally alert to this fact. This awareness invites some glibness in discussing complete information systems. Particularly when pressures for information exist in so many different areas of a school operation.

A complete information system can easily be viewed as a panacea for all the day's difficulties, and it may properly be so for a large portion of them, but it is necessary to reduce these difficulties into specifics in order to produce more than discussion about them.

A complete information system, by implied definition, is one which can produce information required to answer pertinent, thoughtful, and constructive questions raised by parents, voters, curriculum directors, counselors, faculty, students, planners, fiscal administrators, maintenance directors, research departments, and many others. To put the scope of such a program into better perspective, the following brief list of candidates for inclusion in such a system would be considered under this definition:

Student Progress Report

Student Progress Projection Report, compared with achievement

Budgetary Position Forecast

Comparative Program Evaluation

Cost of a Unit of Education

Comparative Achievement Analyses

Individualized Student Instruction
Simulation and Forecasting of Physical Facilities
Student Problem Solving
Manpower Use

A college district is an organization of people, facilities, and equipment. All people require information of various types, in various quantities, and at various times. All people also enter data into the system.

If each division was relieved of the responsibility for distributing information to all other divisions, and with one recording could make it available wherever it might be required, great saving in time would result and much duplication of effort would be eliminated.

What is needed is a system which will shorten and simplify the line of communication. Long lines of communication are shortened or eliminated by recording data at its source as it happens. Data is transmitted to a central information system where it is available to all who require it on a scheduled or inquiry basis through the use of remote display devices.

THE DEVELOPMENT PROCESS

I. File Design

All management information systems (M.I.S.) are comprised of common elements: data, software to access the data, hardware and report formats. The most important of these elements is the data. Data must be designed to maximize utilization and minimize redundancy. Data must also be designed to maximize the potential for correlation. Therefore, the first and most important step in building an effective management information system is data design.

Data design, however, implies the existence of some system to utilize that data. Therefore one must first be aware of the environment one is influenced by and the systems that constitute that environment. The typical college environment and the major systems that constitute that environment are shown in Figure 1. Each of these systems can be further delineated into subsystems as depicted in Figures 2, 3, 4, 5, 6 and 7. Data files and elements to be utilized in the M.I.S., therefore, must be that data currently flowing through these systems and subsystems. One approach to collection of this data is the traditional approach of converting data files from batch processing formats to random access formats. This approach however, does not address the problems of missing or redundant data.

An alternative approach is to thoroughly investigate what data is utilized by the operational units of the college and for what purpose it is used. Figure 8 illustrates a format that is helpful in this investigation.

The analyst records on this form the data element used, what source the data element originates from, and the size and character of the data element

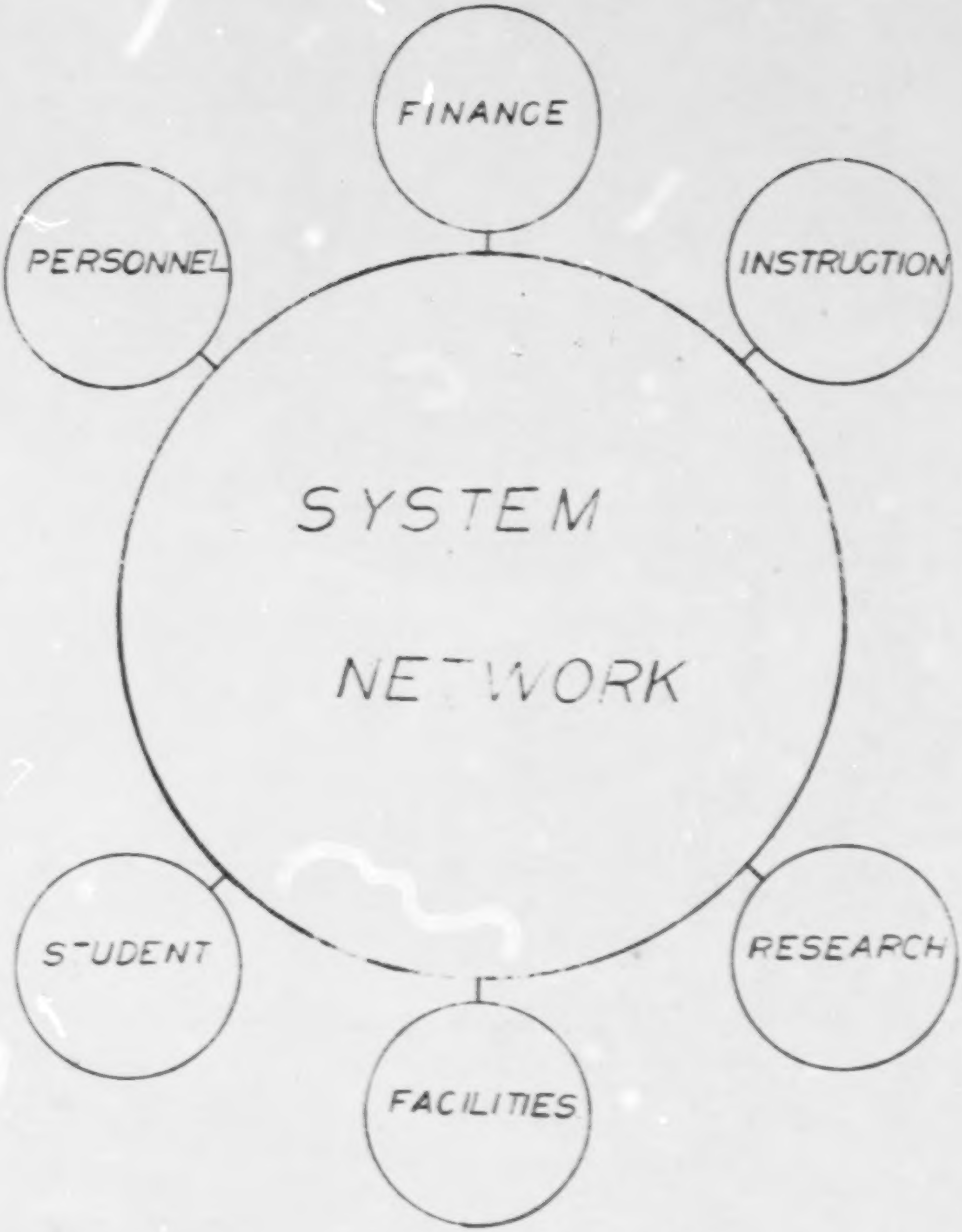

FINANCE
PERSONNEL
INSTRUCTION
SYSTEM
NETWORK
STUDENT
RESEARCH
FACILITIES

FIGURE 1

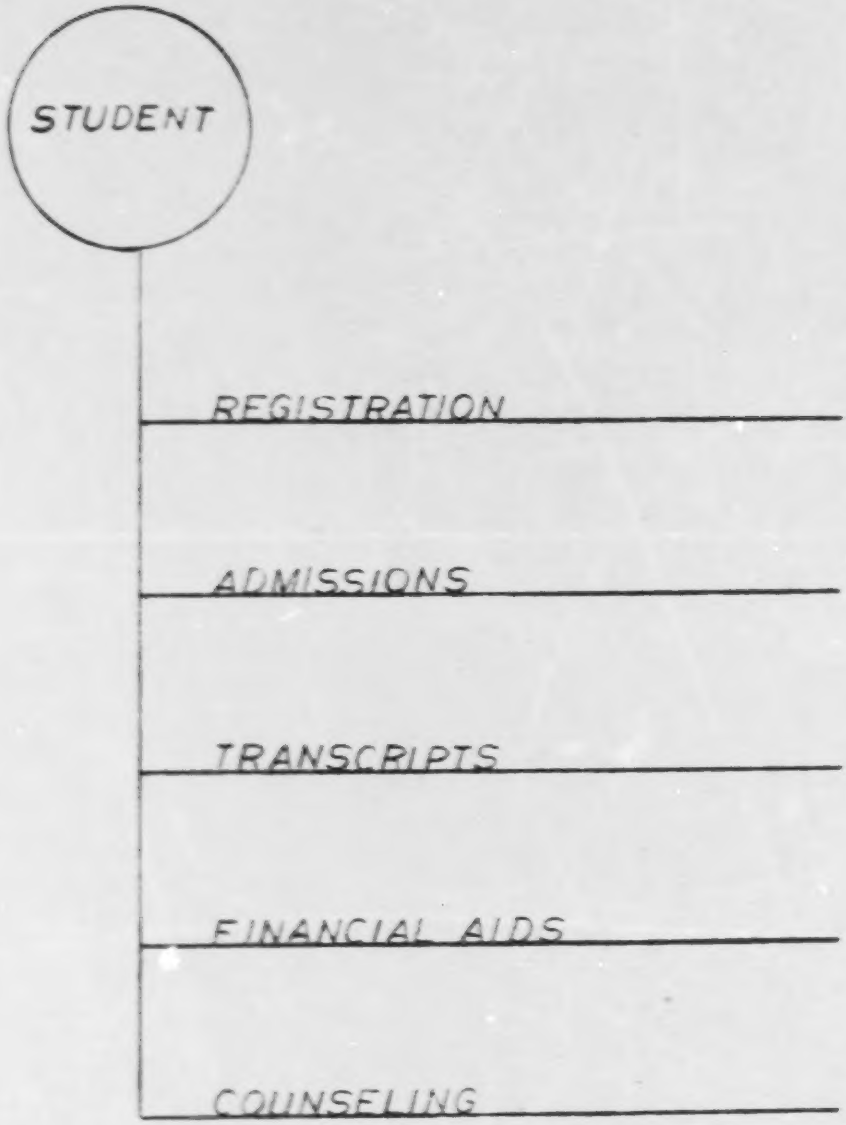

STUDENT
REGISTRATION
ADMISSIONS
TRANSCRIPTS
FINANCIAL AIDS
COUNSELING

FIGURE 2

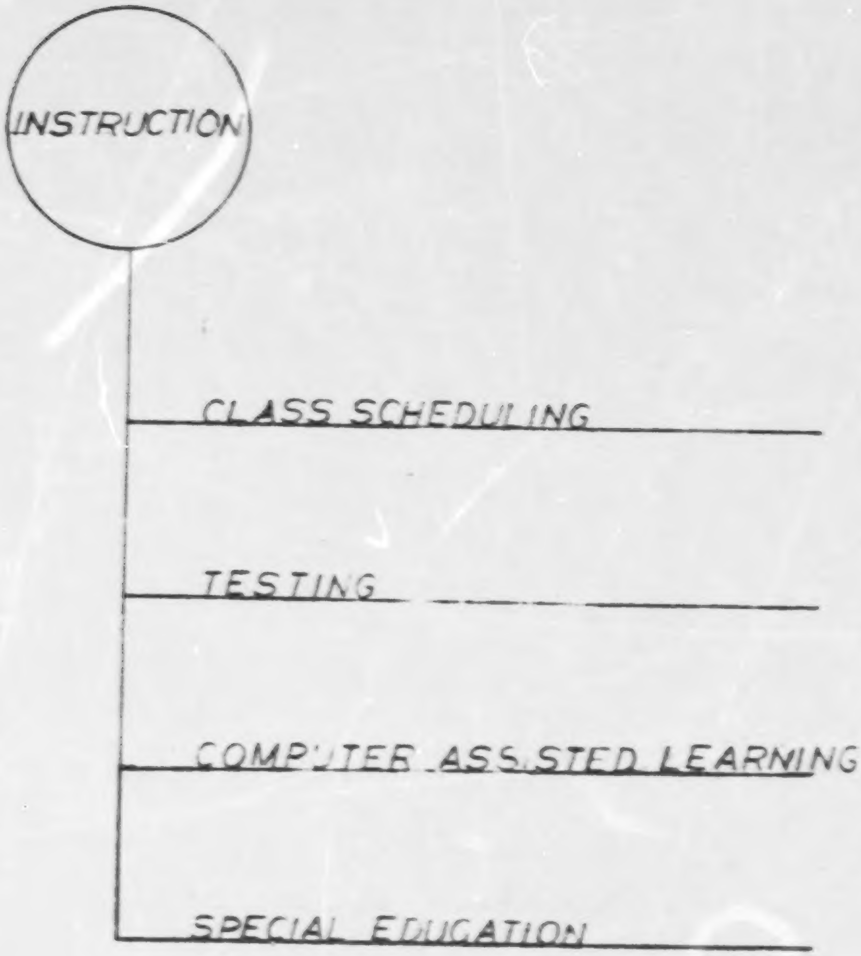

INSTRUCTION
CLASS SCHEDULING
TESTING
COMPUTER ASSISTED LEARNING
SPECIAL EDUCATION

FIGURE 3

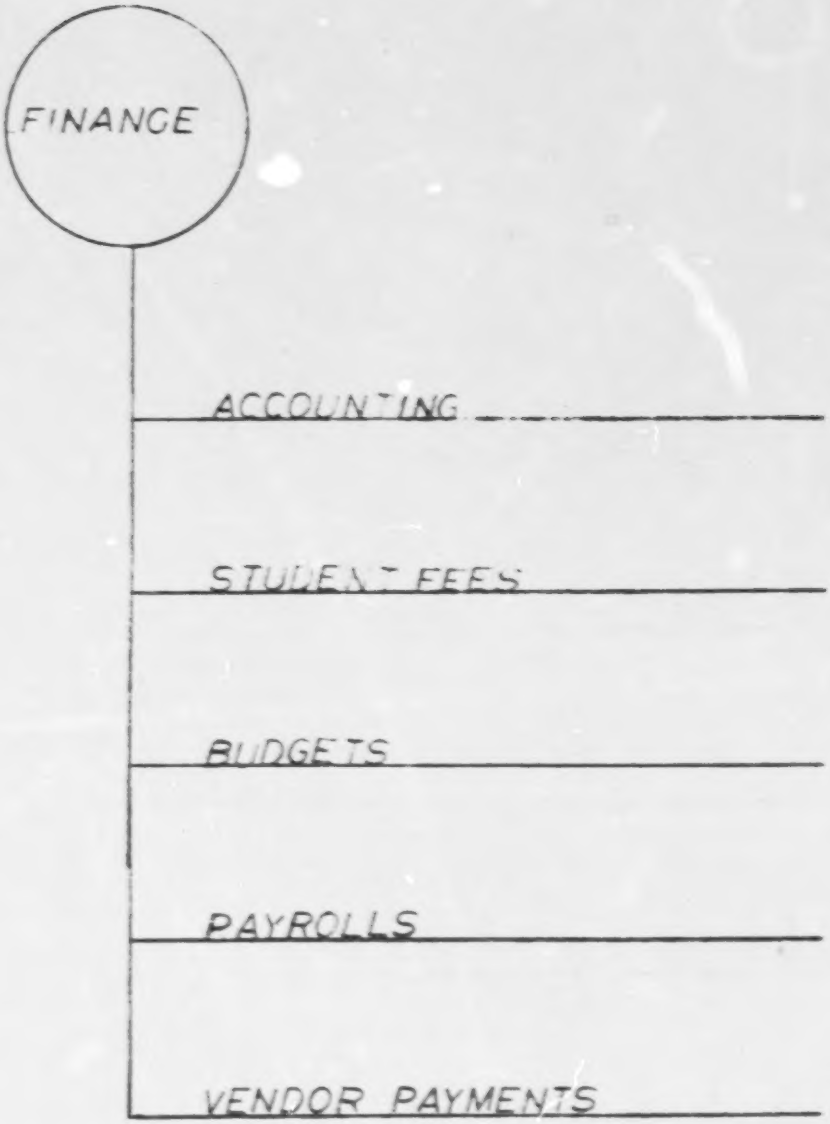

FINANCE
ACCOUNTING
STUDENT FEES
BUDGETS
PAYROLLS
VENDOR PAYMENTS

FIGURE 4

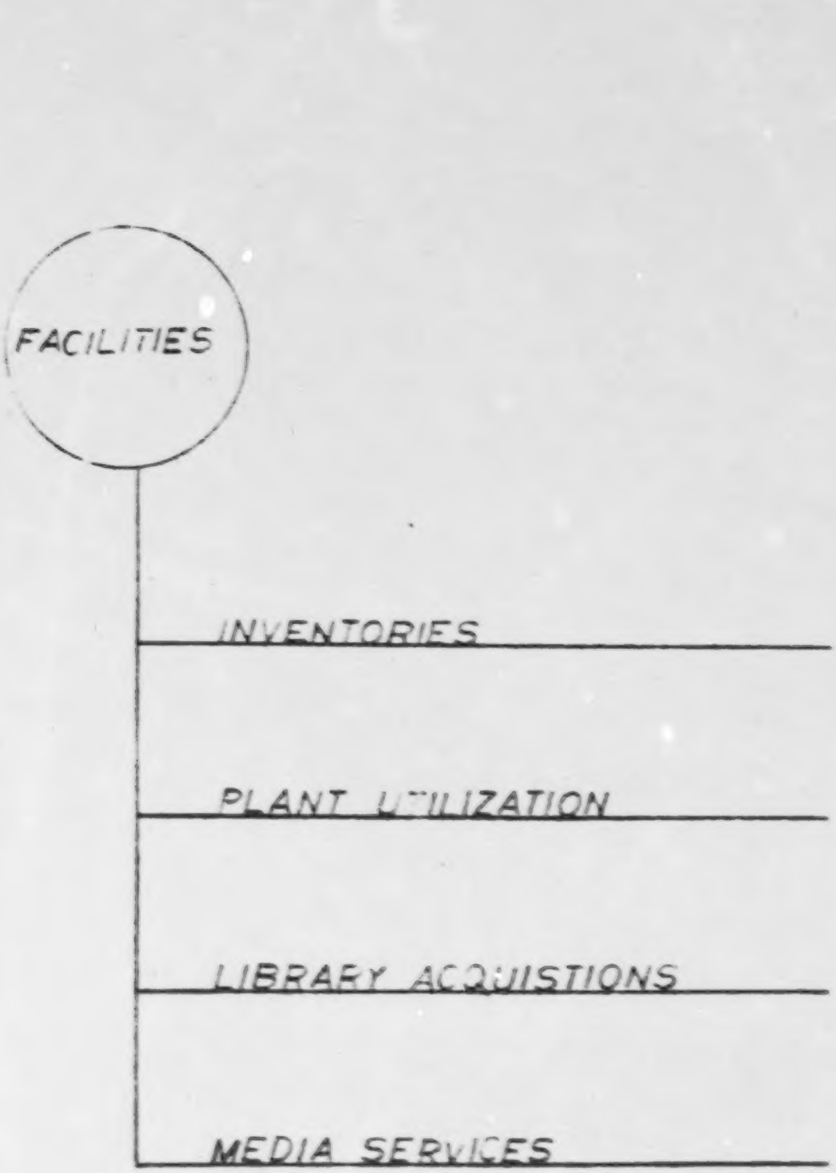

FACILITIES
INVENTORIES
PLANT UTILIZATION
LIBRARY ACQUISTIONS
MEDIA SERVICES

FIGURE 5

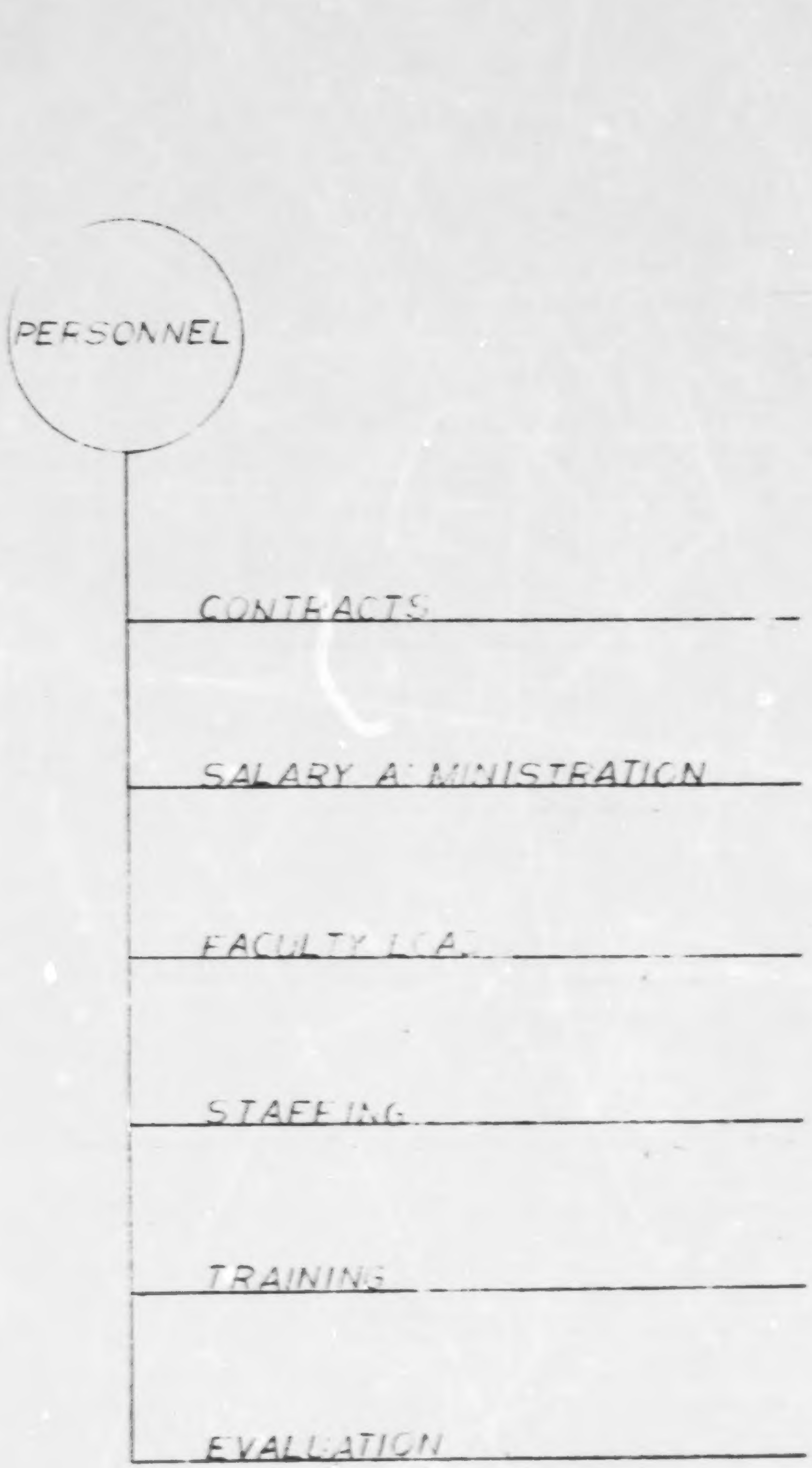

PERSONNEL
CONTRACTS
SALARY ADMINISTRATION
FACULTY LOAD
STAFFING
TRAINING
EVALUATION

FIGURE 6

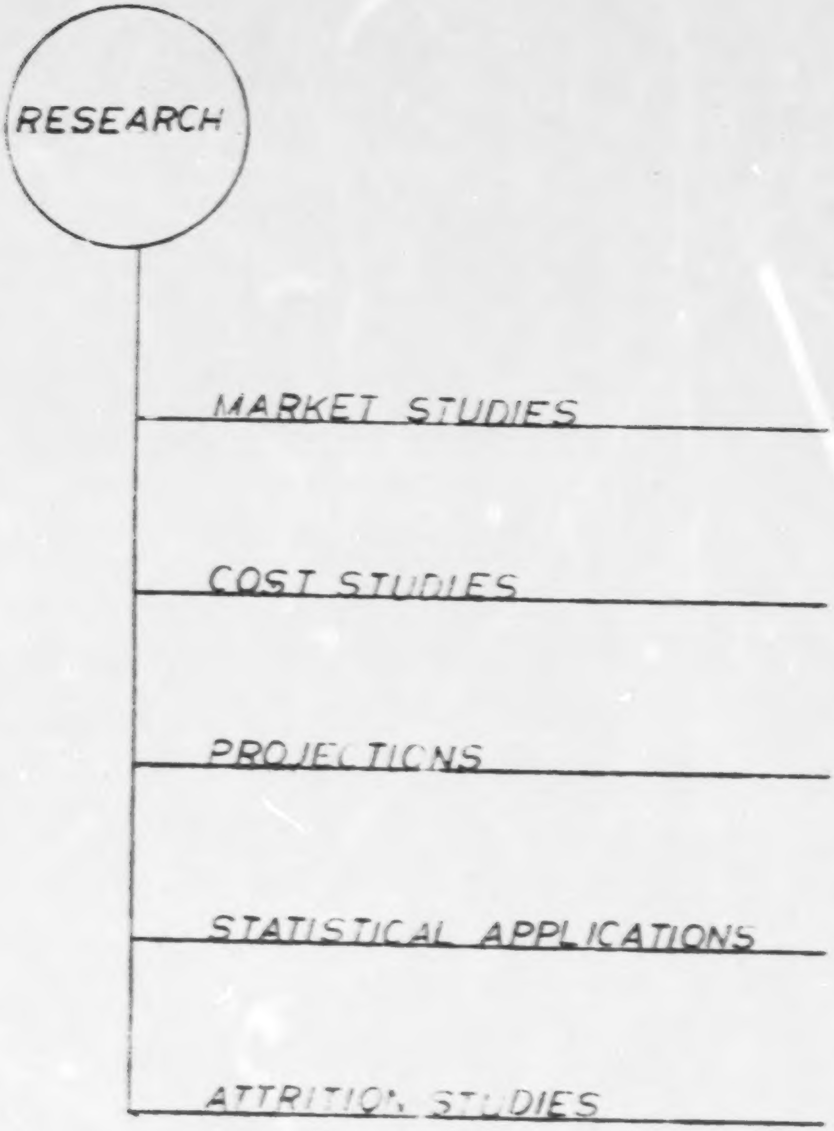

RESEARCH
MARKET STUDIES
COST STUDIES
PROJECTIONS
STATISTICAL APPLICATIONS
ATTRITION STUDIES

FIGURE 7

DATA ELEMENT WORKSHEET

System student Subsystem admissions

Data Element	Source	Description
Student ID	Application Form	9 Digits
Student Name	Application Form	30 Characters

FIGURE 8

(i.e., numeric or alphabetic or mixed). The analyst can use this information as a planning tool to discover data redundancy, to ascertain where source data should originate and to design information files.

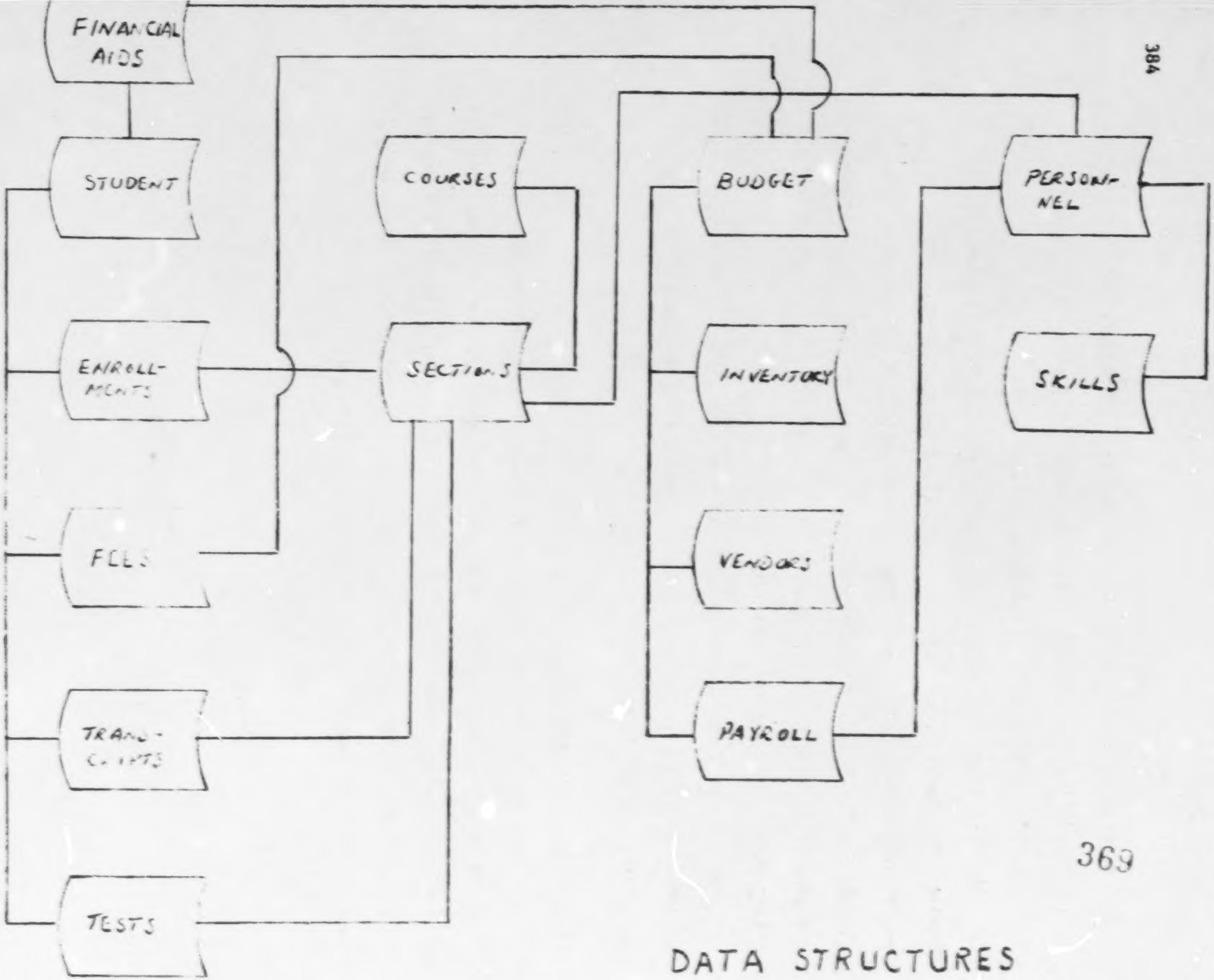
The next step in file design is to indicate the file linkages. It is important (especially with on-line systems) to allow a single transaction to operate on as many data files as possible. Figure 9 illustrates the file linkages in C.T.I.M.I.S. Student information is linked with class information via enrollment data and grade data. Student information is linked with budgetary information via fee data, etc.

Careful attention to file design can result in a more useful M.I.S. when operational. Good file design can also expedite a conversion from a batch to an on-line system.

II. Order of Implementation

On line M.I.S. implementation should commense with that system that provides the greatest cost benefit. All systems of a college exist to support the student and in fact receive their data from student input. Therefore a logical progression for system implementation would start with student system development. Succeeding system development would progress as follows:

Student
Instruction
Finance
Personnel
Facilities
Research


FINANCIAL AIDS
STUDENT
COURSES
BUDGET
PERSONNEL
ENROLLMENTS
SECTIONS
INVENTORY
SKILLS
FEES
VENDORS
TRANSCRIPTS
PAYROLL
TESTS

DATA STRUCTURES

FIGURE 9

such a progression can be graphically represented in pyramid form (Figure 10), where the student, instruction and finance components form the base on which the remaining supporting systems rest. Such an implementaion allows us to support those areas of greatest growth potential with minimum increases in staff support.

III. System Components

The entire M.I.S. system is comprised of (1) data entry equipment, (2) a monitor software product, (3) the computer, (4) a file access method, (5) the data files, and (6) report producing software (Figure 11). A logical progression of component and software development to a full M.I.S. system would be:

CPU Selection
File Design
File Access Software
TP Monitor Selection
Data Entry Equipment Selection
RPG Software Selection

IV. Cost Benefits

Since the implementation of M.I.S. at Columbus Technical Institute, cost of data processing per student has dropped from $80 to $60 (Figure 12). The number of operational personnel required for student registration (as an example) has decreased from eight people to four people. This has occurred during the increase in student body from 1,800 students to 6,000 students. (Figure 13).

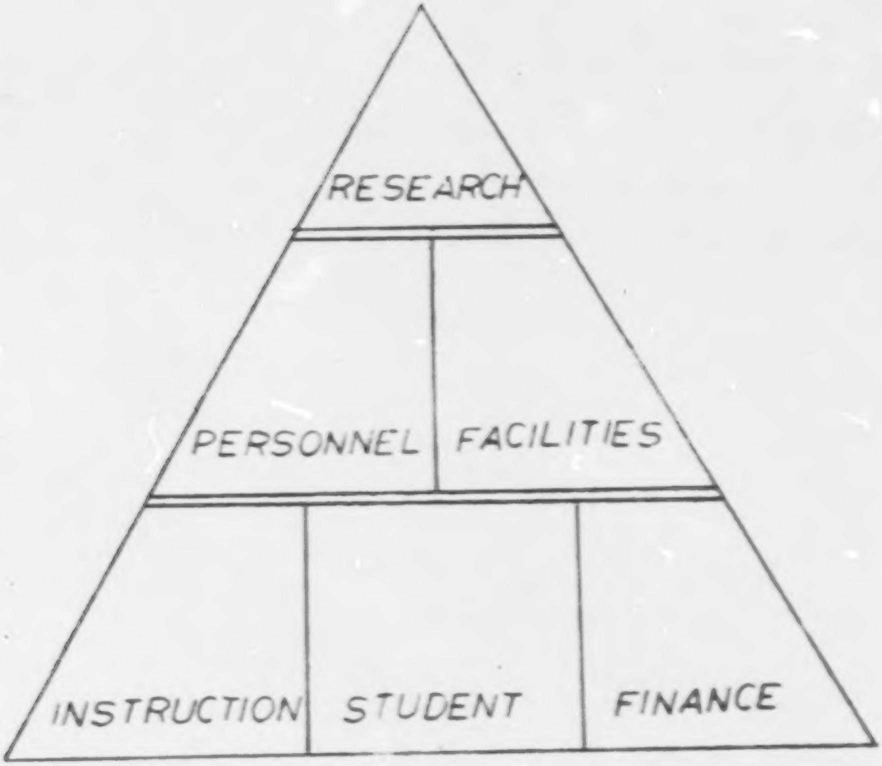
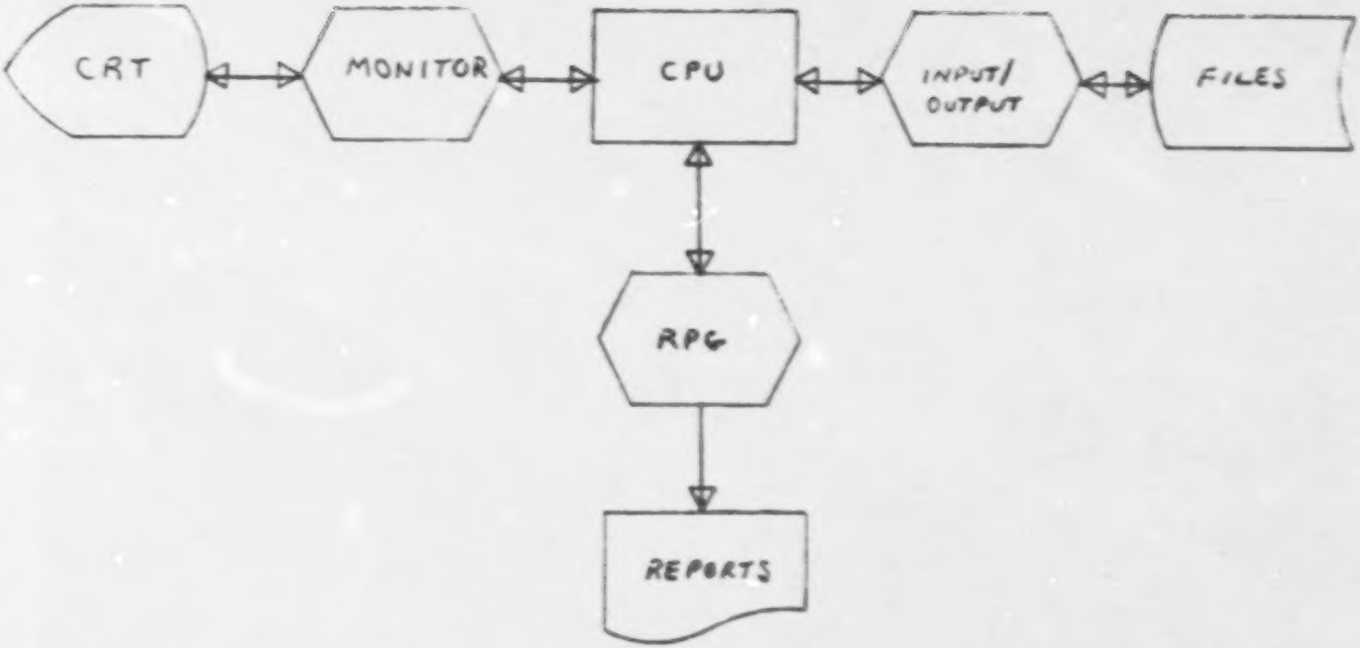

RESEARCH
PERSONNEL
FACILITIES
INSTRUCTION
STUDENT
FINANCE

FIGURE 10

FIGURE 11


CRT
MONITOR
CPU
INPUT/
OUTPUT
FILES
RPG
REPORTS

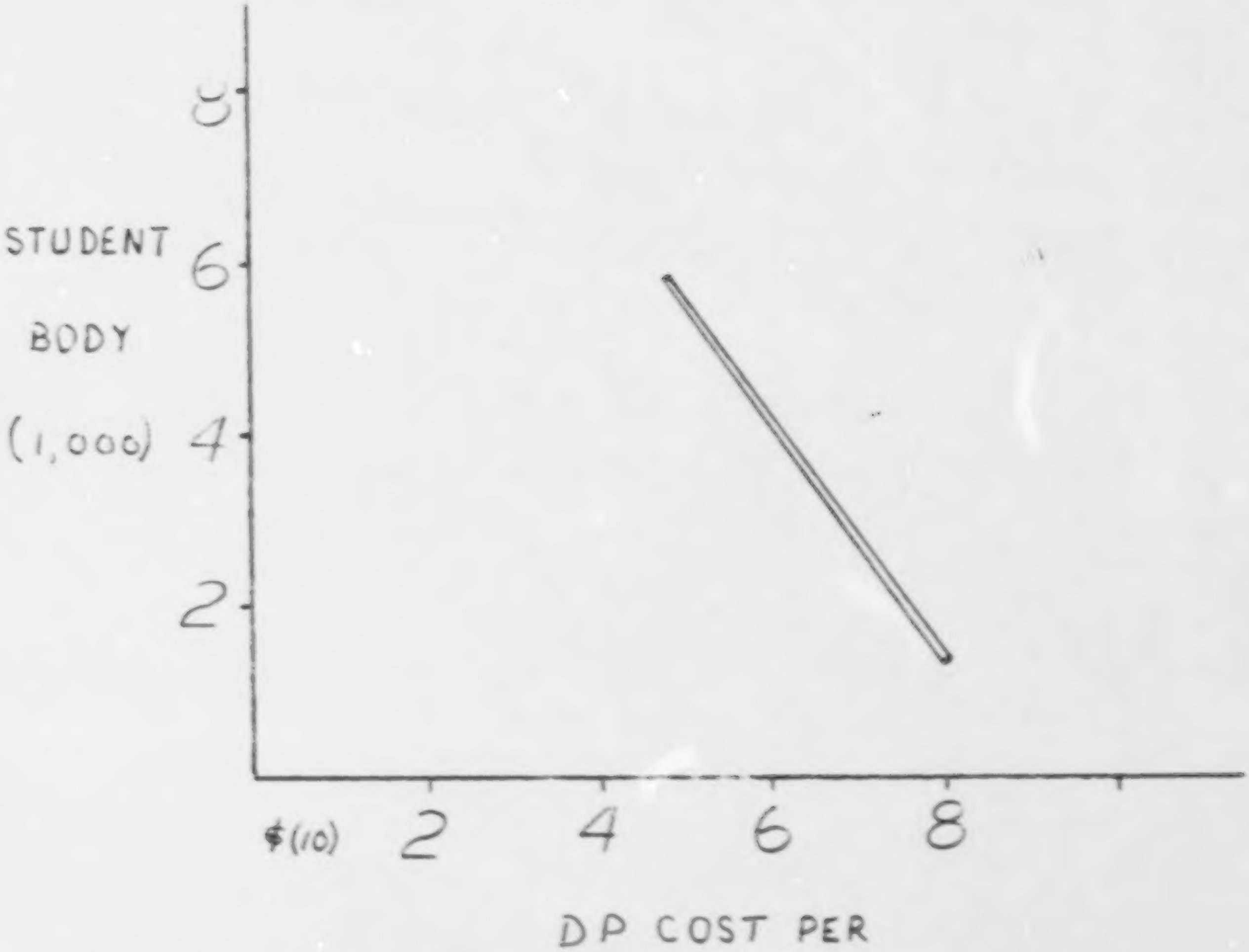


FIGURE 12

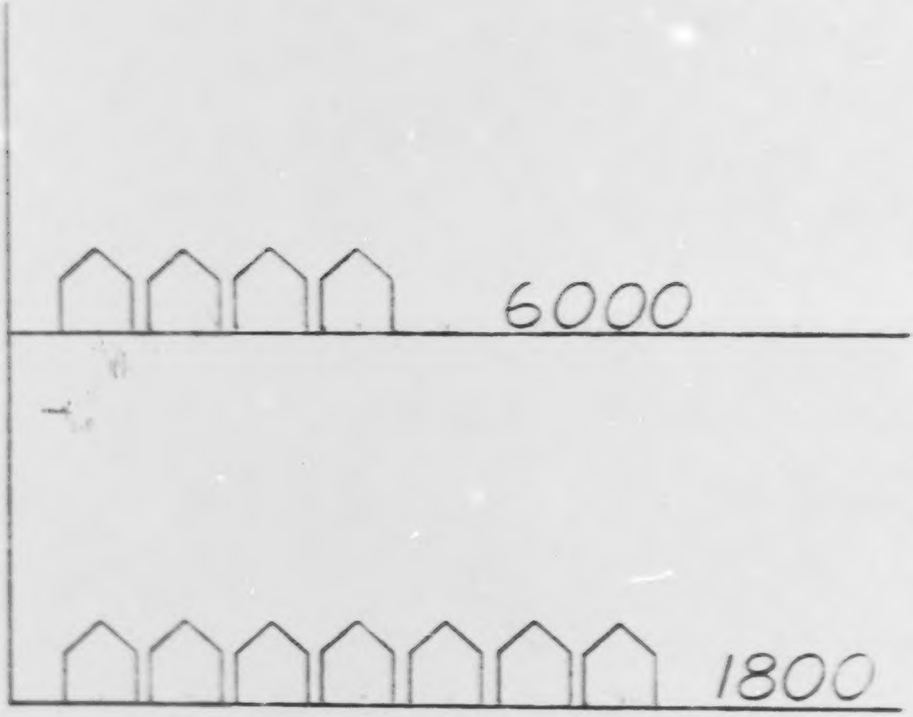


FIGURE 13

V. Project Management

Columbus Technical Institute considers each system or subsystem development as a separate project to deliver a final product. We operate under the project method of management. Each project is detailed as to the steps required for project completion, the time required for each step to be completed and the resource cost of that project broken down by objective.

Figures 14, 15, 16 and 17 are samples of some of the project design documents we utilize. The reader is referred to "education project management", Charles E. Merrill Publishing Company, Dr. Desmond Cook. Dr. Cook's text is an excellent reference for the field of project management.

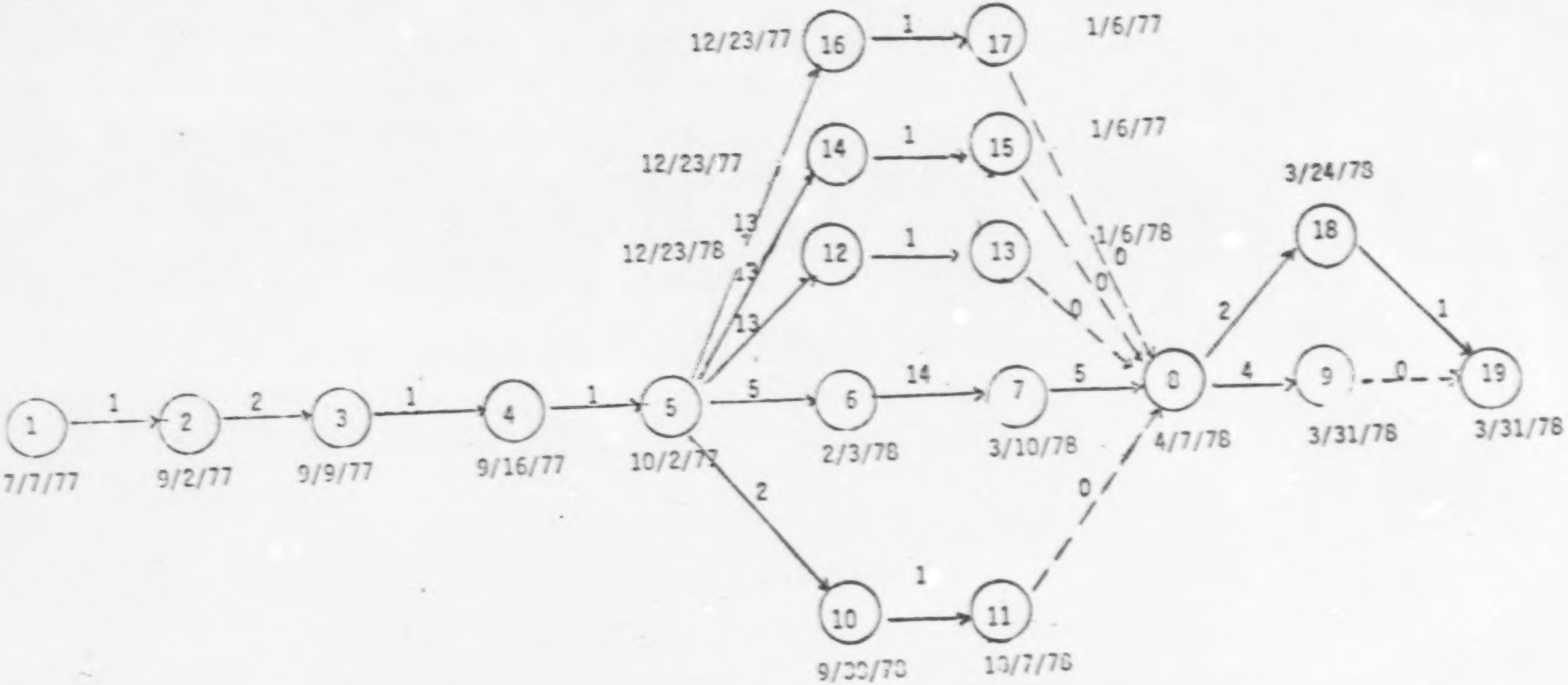
WORK BREAKDOWN STRUCTURE

0	1	2	3	4	5
CICS/VS, IIS, and LIB/OL Operational	System Checkout	Integrated Testing	CICS/VS Installed	CICS/VS Ordered 1.	
			IIS Installed	IIS Ordered 2.	
			LIB/OL Installed	LIB/OL Ordered 3.	
			MIS Reprogrammed	MIS Redesign	Project Manager Selected and Trained
					Program Team Selected and Trained
	Operating System Reconfigured	Operating System Redesigned			
	User's Trained	User Documentation Completed			

FIGURE 14

FIGURE 15

WORK FLOW


12/23/77
16
1
17
1/6/77
12/23/77
14
1
15
1/6/77
3/24/78
12/23/78
13
12
1
13
1/6/78
0
0
0
18
13
13
2
1
1
1
2
2
1
3
1
4
1
5
5
6
14
7
5
8
4
9
0
19
7/7/77
9/2/77
9/9/77
9/16/77
10/2/77
2/3/78
3/10/78
4/7/78
3/31/78
3/31/78
2
0
1
10
11
9/30/78
10/7/78

TIME IS IN WEEKS

Legend for Work Flow Diagram

Activity	Start Event	End Event	Description
1	July 1	July 7	Select Project Manager
2	August 29	September 2	Train Project Manager
3	September 5	September 9	Select Project Team
4	September 12	September 16	Train Project Team
5	September 19	October 21	Redesign MIS
6	October 25	February 3	Reprogram MIS
7	February 6	March 10	Integrated Testing
8	March 13	April 7	System Checkout
9	April 10	March 31	System Operational
10	September 19	September 30	Redesign Operating System
11	October 3	October 7	Reconfigure Operating System
12	September 19	December 23	Order CICS/VS
13	January 2	January 6	Install CICS/VS
14	September 19	December 23	Order IIS
15	January 2	January 6	Install IIS
16	September 19	December 23	Order LIB/OL
17	January 2	January 6	Install LIB/OL
18	March 13	March 24	Complete User Documentation
19	March 27	March 31	Train Users

FIGURE 16

Budget Plan

CTI ACCOUNT	1	2	3	4	5	TOTAL
310	50	150		50	50	300
410					600	600
450					350	350
640	2,000	2,491				4,491
TOTAL	2,050	2,641	-	50	1,000	5,741

Codes:

310	Supplies
410	Training and Conferences
450	Travel
640	Hardware and Software Rentals

FIGURE 17

SUMMARY

The M.I.S. system, as presented within this paper, encompasses the major subsystems being utilized in higher education throughout the United States. This paper presents the Columbus Technical Institute concept at one point in the history of the system.

The data base related to each subsystem is the totality of the individual units and is far more extensive than information processed in aggregations between the subsystems. All reports contribute to the effectiveness of the information system. The aggregate reports created by combining basic elements into desired formats are used for special purposes. These special purposes are of an executive nature and have the flexibility of being modified to the administrative style, governance needs, and operational concepts of other institutions of higher education.

Availability of data processing equipment and a high level of sophistication in software concepts will cause further improvements in the M.I.S. concept. The awareness of managerial specialists, technicians, and faculty will give life to new applications. C.T.I.M.I.S. is a first step in harnessing and directing the potential of technology toward the needs of higher education. Experience will cause refinement and time will allow for sophistication.

THE HUMAN DYNAMICS OF INFORMATION SYSTEMS DEVELOPMENT IN A SMALL PRIVATE COLLEGE

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Vice President for Administration

and

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Assistant Professor Computer Science
Computer Center Director

Saint Mary's College
Winona, Minnesota

The "personality" of a small liberal arts college is a composite of the views and daily behavior of students, faculty and administrators. If an Information System does not complement this personality, major human conflicts result. This paper describes the planning, selection and initial implementation of a mini-computer (PDP-11) based Information System at Saint Mary's College (under the Advanced Institutional Development Program). A review of the guiding constraints illustrates the nature of the problem and the range of possible solutions. Subtopics include financial limitations, educational philosophy, faculty-administration cooperation, planning and management style, student perceptions, available technology and professional staff experience.

In the seven-year period, 1970 to 1976, thirty-seven private four-year colleges ceased operation and thirty-six private two-year colleges closed their doors. An additional twelve private two- and four-year colleges switched from private to public ownership.[1]

Talk and evidence of such closings are guaranteed to strike fear in the hearts of all small college administrators and trustees. They are also important considerations for the information system specialist who wishes to install a new or improved system, for if a system is to meet the needs of the organization, the prime motives of that organization must be identified. If a system for private business were being developed, it would be appropriate to consider whether the prime motive was profit, growth, share of the market, risk avoidance or some other. These same motives, excluding profit, may also be appropriate for small colleges, but the most obvious motive these days is survival. In fact, the obligation of the Board of Trustees is, first of all to assure the survival of the institution.

Some might object to this seemingly callous focus on survival. Most colleges have rather elaborate and comprehensive statements as to the mission of the institution, which say in some depth what it is trying to do. These statements are important as goals, but they are equally a "formula for survival" or a "rationalization for survival." In other words, colleges hope to survive by fulfilling their mission. They also believe that it is right that they survive because their mission is honorable.

The search for survival may take one of several forms. To understand in depth a particular small college, one must determine its key survival strategy. One possibility in a private college is an emphasis on cost effectiveness, where education is viewed as a cost competitive situation, particularly in comparison with publicly funded institutions. Another possible emphasis might be innovation. In a search for college-bound students, innovative academic programs may attract sufficient numbers to insure institutional survival. Another survival strategy could be retrenchment, or a return to the more traditional disciplines of the liberal arts.

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[1] "Private Colleges Closed or Shifted to Public Control," Chronicle of Higher Education, November 21, 1977.

Any of the above may, for a particular school, turn out to be a successful strategy, but the key strategy for Saint Mary's College is planning. This strategy developed concurrently with an increased concern for information systems. Planning and information systems are activities which feed upon each other. Information is needed for both planning and decision making, while the development of more sophisticated information systems requires a greater concern for the managerial activity, planning. Institutional planning is the subject of a later section of this report. This section discusses information systems development.

INFORMATION SYSTEMS DEVELOPMENT

Information systems planning must consider the human dynamics of the institution, those "people factors" which contribute to the success or failure of such endeavors. Six of these "people factors" are offered for consideration: money, faculty/administration conflict, student body, management style, administrative staff, and computer center staff.

Money

The first of several people factors which influence information systems is money, or more precisely, attitudes toward money. Money is a very scarce commodity for the private college, and computer hardware and software make heavy monetary demands. The information system specialist should try to determine the institution's past methods of funding major expenditures. Such potential sources as major fund appeals, foundation grants, government programs, and general operating funds must be considered. The source itself may well influence decisions as to size of equipment, new vs. used, rent/lease or purchase, and the size of the computer support staff.

At Saint Mary's College, the preferred sources are foundations and government programs. The first computer, an IBM-1130, was obtained in the late 1960's through an NSF grant. In 1974 the college wrote a major proposal for funding new programs under the Advanced Institutional Development Program administered by the Office of Education under Title III of the Higher Education Act. It was natural for the institution to include expansion of both hardware and software as a major support portion of that grant program. The proposal was approved and funds awarded in 1975; this report largely focuses on the experience gained during the first two years of this five-year AIDP grant.

In addition to identifying the source of funds, the information system specialist must determine the amount of funds available. Computers come in all sizes and prices. Each could, in its way, serve the needs of the small private college. When determining the size for a particular institution, one must find out how much expense the institution can and will readily support. This amount can vary widely, but a good rule of thumb is to cut in half the amount the administration is afraid it might have to spend. For example, Saint Mary's had earlier investigated the possibility of obtaining a used IBM-360. Purchase prices approximating $200,000 had been bid, but the project failed to materialize. Therefore, a target hardware cost of $100,000 was determined as the appropriate amount for the college. This amount was further subdivided into various components directly related to benefits the college hoped to realize. By considering individual components (the largest at $55,000 for the basic mini-computer time-sharing system), the administration was able to evaluate the project in relation to normal expenses of the institution.

One word of caution is needed for the specialist who selects (or is forced to select) an external funding source for the system. Once funded, the cost/benefit analysis which should continue throughout the development is likely to be minimized. The external funding agency or source will likely focus on the achievement of stated objectives, but this will come after the money has been spent. Internal review may well be cursory, since, after all, it's outside money. The system should not be exploited, or the day will come when the institution does ask what was achieved by spending all that money. Honest evaluation becomes the responsibility of the computer center to a larger degree than might normally be expected.

Faculty/Administration Conflict

An underlying factor in most institutions is some degree of conflict between the faculty and the administration. Faculty think there are too many administrators. Administration thinks faculty are trying to run things without understanding the long-range problems. These conflicts may be major or minor, hidden or obvious, friendly or destructive. The information system development will take place in the existing atmosphere and may get inextricably entangled in such conflicts. The decision in favor of a central computer center, rather than separate centers, must consider the level of this conflict. The conflict level at Saint Mary's is minor, open and generally friendly. As a result, a central computer facility can be shared by administrative and academic users, resulting in decreased expenditures.

The wise specialist will also understand how the system may aggravate conflict. Administration wants information regarding the productivity of the academic program. Faculty resist being measured or evaluated quantitatively. The computer is likely to be blamed for any increase in such measurement activity. Perhaps the only effective countermeasure for this situation is an honest concern for increasing academic computer support for the benefit of the academic departments and programs.

Student Body

When one mentions students to a computer center director, thoughts of security, confidentiality, vandalism and other dangers come to mind. There is some experience which supports such fears, but one must recognize that viewing students as enemies of the institution is hardly compatible with the normal mission of the small liberal arts college.

Students are a part of the institution and, therefore, have information needs for their own decision-making purposes. Dangers may be minimized if these needs are met and are perceived as being met. Some of the simple steps have already been taken. For example, it is no longer necessary for students to stand in long lines for class registration. It is, however, possible that students do not have an easy way of determining whether graduation requirements are being met. Students may also not have the best information necessary for making career decisions or determining what options are available to them following graduation.

At Saint Mary's College, the Student Senate has the responsibility for conducting faculty and course evaluation. Computer center support is needed for this activity. Students are also a work resource for the center. They can write certain administrative and academic computer programs for the center, if standards for file design and documentation have been established. However, colleges should avoid the trap of having students produce programs which require their continued presence for maintenance and operation.

Management Style

Burch and Strater identify an important "people factor" in stating, "The manner in which information flows within the organization depends basically on two things: (1) management philosophy and (2) the approach used to design information systems."[2] It might seem easy to determine whether the management style is either autocratic or democratic, centralized or decentralized, personal or impersonal. The information system specialist may find, however, that any one small college has elements of all styles: Teachers, who tend to be the autocrat of the classroom, may retain this style as they move to administrative positions. Offices that perform their functions efficiently and effectively may enjoy a large amount of decentralized authority. The faculty body may jealously guard for itself certain decision-making roles. Some committees will have effective authority, while others will be mainly advisory.

An integrated information system works best in an environment of integrated management. Admittedly, the diversity of style at Saint Mary's College is a source of concern regarding the proper system design. Perhaps all that can be achieved at this time is a best fit; the optimum system awaits further evolution of management style. The approach selected is a distributed information system with integration of the data base and integration of the top-level planning data. The transactional systems are tailored to the needs of individual offices.

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[2] John G. Burch and Felix R. Strater, Information Systems: Theory and Practice, Hamilton Publishing Company, 1974, p. 74.

Administrative Staff

A change in the information system has daily impact on the various offices of the college. Because the success of such a change is, in large measure, a function of the readiness of user personnel to work with the new system, an analysis of this readiness should be made prior to the decision to implement a new system. The perceptive specialist is likely to discover that all offices do not have the same degree of readiness. Some offices will be functioning well with the old system and, therefore, will have little incentive to change. On the other hand, offices which have severe limitation problems with current methods will welcome a new system.

Furthermore, it is a mistake to assume that the clerical personnel and the administrator of an office have the same desire for a new system. If a new system is radically different or entails the learning of new work skills, resistance may arise from clerical personnel who previously favored some change. If the new system is procedurally different, the administrator may feel that it weakens his or her control of the office.

An information system philosophy concerning the care and ownership of the data base needs to be specified. In a highly integrated system or in a service-oriented system, the computer center might be viewed as the owner of the data. Other system designs might establish the user office as the owner of the data. Obviously, this choice affects the various administrative offices. If a change is being made, consideration must be given to the ability of the office to adapt to a new data-ownership concept.

The Saint Mary's College approach to this people factor is to opt for office ownership and maintenance of specific files in the data base. This represents a change for some offices, but not for others. Identification of the offices with the greatest need and readiness helped to establish the schedule for a phased implementation of the new system. On the assumption that offices talk to each other, it is important that the first installation be pleasant, successful and viewed as a work reduction with increased benefit.

Computer Center Staff

A major factor limiting the development of an information system for the small college is the quality and quantity of computer center staff. Although the number of personnel assigned to this function is limited by the size of the institution, design and development work are likely to be somewhat independent of size. It is difficult to attract quality to the small institution, because of such factors as salary level, unwillingness to fund state-of-the-art projects, and lack of promotion opportunities. One must take as a given the available staff and individually develop the potential of each member.

The computer center organization chart for Saint Mary's College, included as Figure 1, shows the many responsibilities assigned to each staff position. Two positions, Director of Administrative Computing and Director of Systems Computing, are full time. The Director of Academic Computing is one-half time, while the Director of the Center is approximately one-quarter time. Two computer/keypunch operators are full time; several students work up to ten hours per week in the center. The college is fortunate that its professional staff averages ten years' experience in computing and four years' longevity with the institution.

Good computer people are creative. This attribute is both a curse and a blessing for the small institution: a curse in that individuals would prefer to spend more time in original design; a blessing, in that they have the ability to handle such diverse job descriptions.

One necessary ingredient for success in the small college is an honest

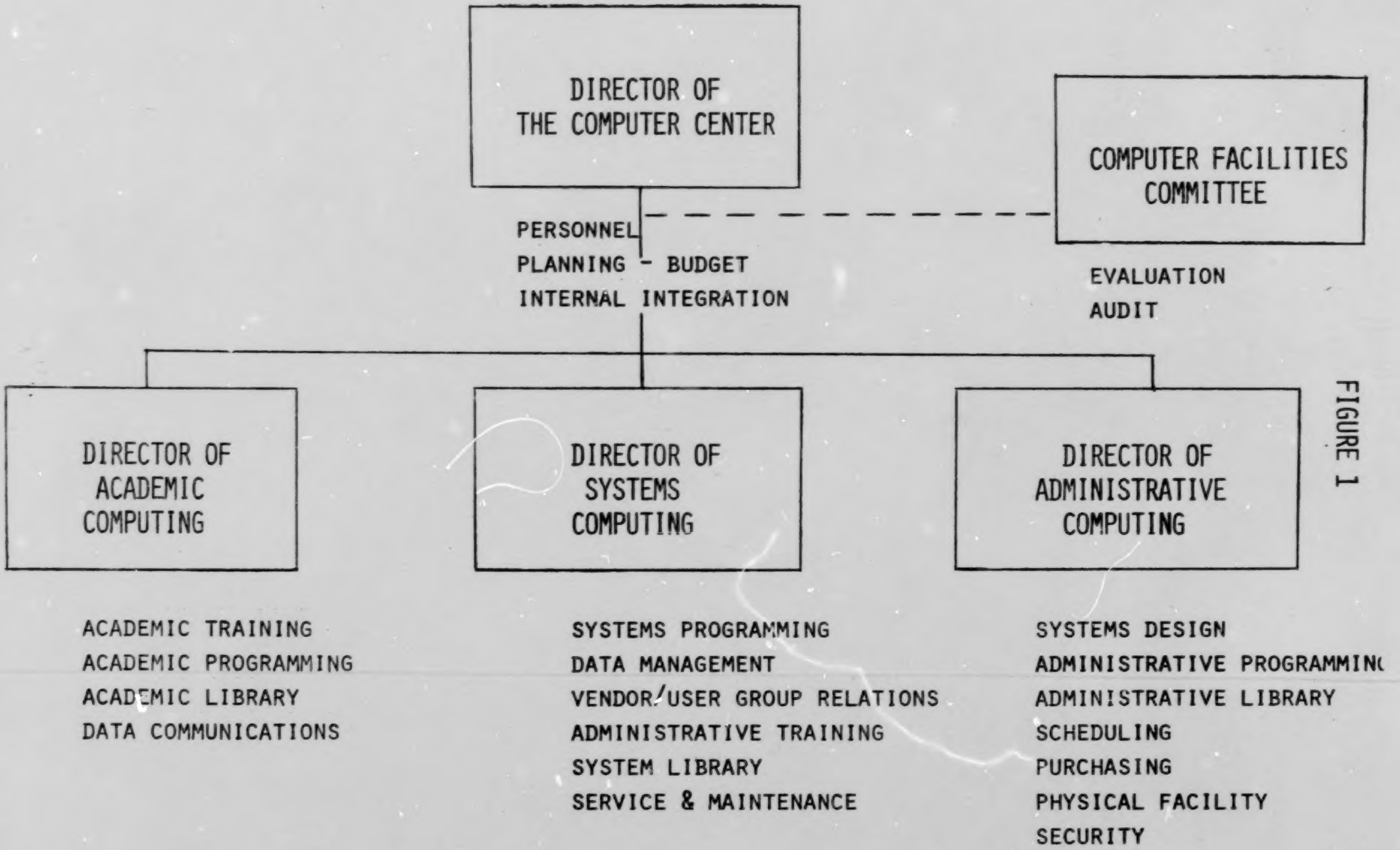

DIRECTOR OF THE COMPUTER CENTER
COMPUTER FACILITIES COMMITTEE
PERSONNEL
PLANNING - BUDGET
INTERNAL INTEGRATION
EVALUATION
AUDIT
DIRECTOR OF ACADEMIC COMPUTING
DIRECTOR OF SYSTEMS COMPUTING
DIRECTOR OF ADMINISTRATIVE COMPUTING
ACADEMIC TRAINING
ACADEMIC PROGRAMMING
ACADEMIC LIBRARY
DATA COMMUNICATIONS
SYSTEMS PROGRAMMING
DATA MANAGEMENT
VENDOR/USER GROUP RELATIONS
ADMINISTRATIVE TRAINING
SYSTEM LIBRARY
SERVICE & MAINTENANCE
SYSTEMS DESIGN
ADMINISTRATIVE PROGRAMMIN
ADMINISTRATIVE LIBRARY
SCHEDULING
PURCHASING
PHYSICAL FACILITY
SECURITY

FIGURE 1

concern for the institution. The center personnel cannot be so engrossed in the computing profession that they fail to see how the center can best serve the needs of the college. Furthermore, the staff must be perceived by other administrators as part of the team and not as an appendage which is somehow necessary, but difficult to understand.

With these six people factors in mind, it is appropriate to review the various options which face the small, developing institution. Options referring to location, system, software, hardware and operation were important for Saint Mary's College. Figure 2 summarizes these options, but a few explanations here will clarify the ultimate selection.

Several location options were available to the college. In a town of 26,000 and three colleges, each was operating its own computer facility. The opportunity for a consortium was certainly present. A former staff member of the college had recently formed a computer service bureau which could have provided additional capability. Furthermore, Minnesota has an extensive statewide time sharing network for academic use.

Each of these resources was considered before the decision was made to expand the college's own on-site operation. It was a poor time to consider a computer consortium. This had been explored previously and some hard feelings remained among those who viewed it as an institutional power play. The local state university was losing its administrative capability, for a state-wide system was being installed elsewhere. The local service bureau was a strictly batch shop, operating several IBM-1401 systems, which limited the type of operation available to the college. The state's academic timesharing network had just installed new equipment and was unable to run anything except BASIC. The concurrent nature of these circumstances led the

FIGURE 2

INFORMATION SYSTEMS OPTIONS

LOCATION	ON-SITE
	CONSORTIUM
	REGIONAL NETWORK
	SERVICE BUREAU
SYSTEM	INDEPENDENT MODULES
	INTEGRATED SYSTEM
SOFTWARE	COMPLETE PACKAGE
	VENDOR
	THIRD PARTY
	EXCHANGE GROUPS
	ORIGINAL DEVELOPMENT
HARDWARE	SIZE
	POSITION IN A FAMILY
	STATUS OF VENDOR
	BATCH
	TIME-SHARING
OPERATION	OPEN SHOP
	CLOSED SHOP

college away from any system which was not subject to the wishes and needs of the college itself.

The basic system options were the fragmented transactional systems approach or the integrated information system approach. Actually, this decision was not in terms of which one to choose, but how much integration could be done and in what way. A smoothly functioning set of transactional systems is mandatory for an effective integrated system. Then, too, the necessary aggregation of information for planning must come from the separate systems needed for day-to-day operation. Integration of the system results from a systems study focusing on the needs of the institution. This study, and the subsequent design and development work, can be so lengthy as to result in a college's having three years from now what was deemed optimum several years before.

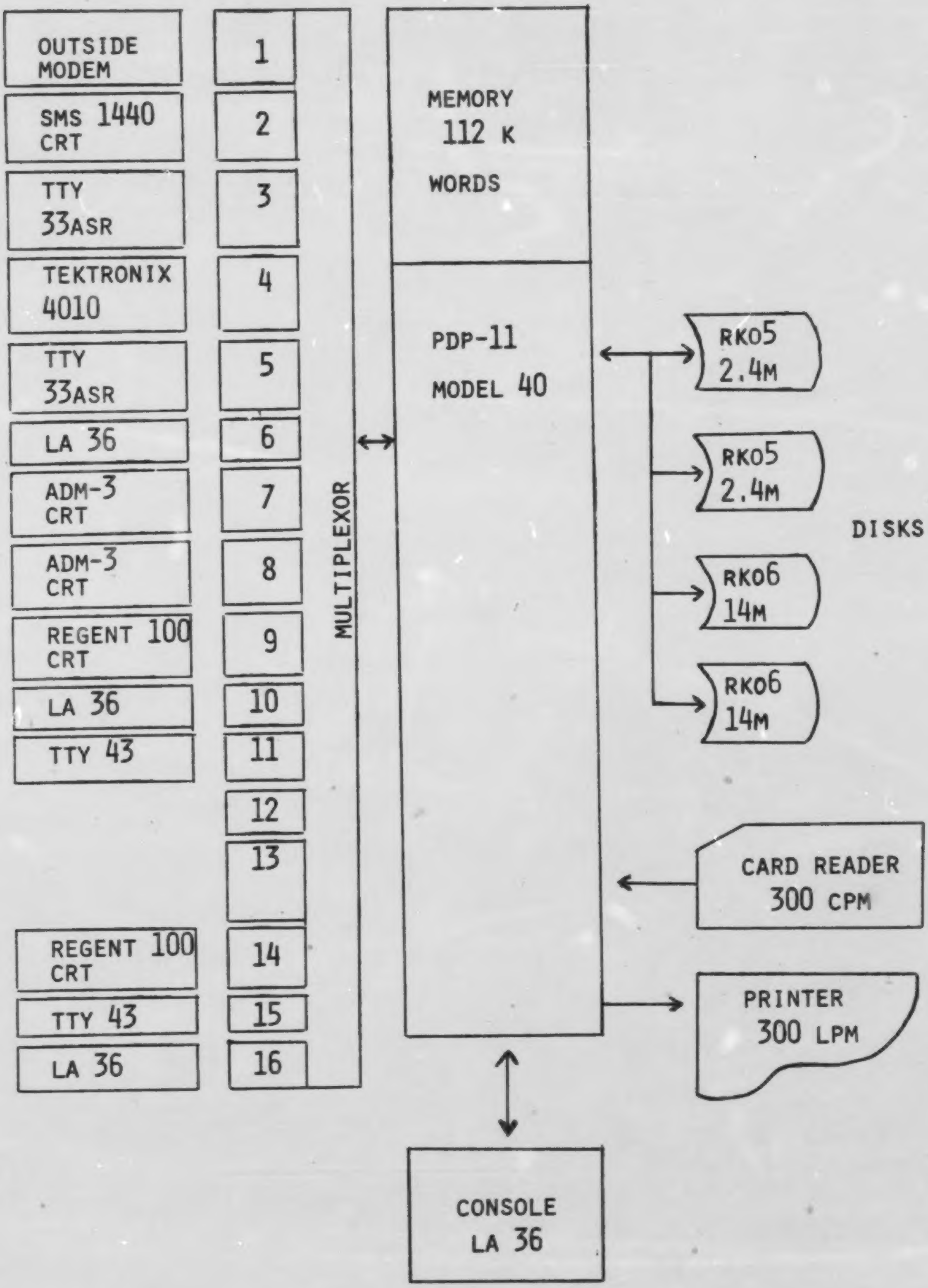
A dual approach has been taken at Saint Mary's College. An integrated system requires an easily accessible data base. Transactional systems are also improved by operating from a common data base design. While an outside consultant was helping college management define its goals, objectives and needs, the computer center staff would somehow convert the individual transactional systems to a common data base design. This attack may be viewed as both top-down and bottom-up, with a great deal of faith that both activities will meet in the middle.

Associated with the system options are software options. Ranging from complete packages to completely original development, these options limit the system alternatives. Actually, an institution does not have to use only one of the options. The choice at Saint Mary's was to purchase a system, WISE, from the computer vendor. This package supplies the data base software needed, includes the necessary utility routines, provides some transactional programs which the college did not have, and allows for expansion through user-written extensions. The college also participates in exchange organizations such as CAUSE and ASCUE (Association of Small Computer Users in Education). In some cases, programs are available which can be used with no change. In most cases, what is obtained is a model upon which to build programs which meet the distinctive requirements of the college.

There are many hardware options to be considered, and the list is growing each year. One may select major or minor vendors; batch or time-sharing systems; micro, mini, midi or maxi; top-of-the-line, middle-of-the-line or bottom-of-the-line. Saint Mary's had operated an IBM-1130 for both academic and administrative purposes by allocating blocks of time to each function. The desire to continue such dual use, with the elimination of block scheduling, led to the choice of a time-sharing system. The available funds dictated the selection of a mini system rather than something larger. Recognition of a future need to grow led to the choice of a middle-of-the-line system. After sorting out these options, the college selected the PDP-11 Model 40 from Digital Equipment Corporation. This selection was also in accord with a desire to stay with a vendor having a large compatible customer base. Figure 3 shows the college's current hardware configuration. The college has no intention of disposing of the IBM-1130, for as transactional systems are moved to the new system, academic use of the IBM-1130 will increase.

Small colleges have traditionally chosen the open-shop operation, as opposed to the closed-shop of large universities. In a center which processes sensitive student information, this open access is a concern. This remains an unresolved issue. An open-shop environment will be maintained as long as possible, with serious attention given to safeguarding the privacy of information. If such attempts fail, it will be necessary to isolate the

FIGURE 3


OUTSIDE MODEM
SMS 1440 CRT
TTY 33ASR
TEKTRONIX 4010
TTY 33ASR
LA 36
ADM-3 CRT
ADM-3 CRT
REGENT 100 CRT
LA 36
TTY 43
REGENT 100 CRT
TTY 43
LA 36
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
MULTIPLEXOR
MEMORY
112 K
WORDS
PDP-11
MODEL 40
RK05
2.4M
RK05
2.4M
RK06
14M
RK06
14M
DISKS
CARD READER
300 CPM
PRINTER
300 LPM
CONSOLE
LA 36

two computers in order to allow students hands-on experience with the IBM-1130.

PLANNING, MANAGEMENT AND EVALUATION SYSTEM

This presentation of "people factors" and information system options describes the specific context in which Saint Mary's College is evolving its planning, management and evaluation style. The college is rural, coeducational, small (1,200 fulltime undergraduates), in the middle third in private-college tuition charges, primarily residential and "adapted liberal arts" in tradition and practice. The Christian Brothers, who administer Saint Mary's and foster its friendly, practical and open spirit, are joined by a diversified faculty and professional staff, all of whom are concerned that the college and its students live the present and face the future with some sense of purpose and direction.

The past decade has witnessed both a growing need for information and a gradual evolution of a planning style. In 1967, Saint Mary's established its office of institutional research, rented the IBM-1130 computer and began to build a data base and program library to deal with the increasingly complex task of managing the college's information flow.

The college participated that same year in CAP:SC (Computer Assisted Planning: Small Colleges), a project to build a long-range planning simulation and decision making model. In spring, 1968, the office of institutional research published the first compilation of a continuing annual series of institutional data, Information for Decision Making. In autumn of 1968, the college purchased the IBM-1130 system, with the help of a National Science Foundation grant.

Between 1968 and 1972, a new and broadly participatory style of institutional decision making came into being at Saint Mary's. The restructuring of the Board of Trustees, the Faculty constitution and committee structure, the Student Senate's representation on academic, administrative and student life committees, the appointment of a vice president for each of four administrative areas (academic affairs, administration, college relations and student development) and the coordination of academic departments into four divisions provided all sectors of the college a role in institutional planning and decision making. These changes, besides causing planning and decision making to be more involved and time consuming, generated a greater need for information processing.

Although infrequent long-range planning sessions had been held prior to 1972, it was in that year that the president established the college's Planning Committee as it now exists. Current membership (1977) includes the following eleven persons:

President of the College
Vice President for Academic Affairs
Vice President for Administration
Vice President for College Relations
Vice President for Student Development
Chairperson of the Faculty
Two Faculty Members Appointed by the Faculty
President of the Student Senate
Two Students Appointed by the Student Senate

The Planning Committee prepared and presented the first Planning Report to the Board of Trustees in April, 1974, the first time in the college's history that a planning document of any scope had been achieved.

The college also developed a Computer Science Department during this same decade, culminating in the approval of a Computer Science major in 1974. Parallel development of academic and administrative computer applications has certainly been mutually beneficial to both programs.

The awarding of a five-year Advanced Institutional Development Program (AIDP) grant to Saint Mary's in June, 1975, marked the beginning of an intensive phase of information system development and overall institutional planning. The complex nature of the AIDP grant (1.5 million dollars spread among 25 different projects over five years), the requirements for monitoring and reporting AIDP activities, and concern that these activities be well integrated with existing programs and operations required the full and rapid development of a Planning, Management and Evaluation (PME) System. The AID Program provided both the impetus and the model for the PME System which Saint Mary's began designing and implementing in 1976.

This PME System involves six components, some of which need to be developed concurrently:

1) Development in top-level decision makers of an understanding of the PME systems approach.
2) Review and design of information gathering and reporting procedures and of decision making processes - at both top level and operational level. This review process includes the kinds of information currently available, as well as the determination of additional information needed for decision making.
3) Operation of the PME System designed by and for the college. The president determines the timetable, allocation of resources and priorities for implementation in various administrative and program areas.
4) Design and implementation of necessary modifications in the college's various Transactional Information Systems by creating the integrated data base for a Management Information System

and by making the data directly accessible to operational units through remote terminals in selected administrative offices.

5) Selection from the software market and modification for use with the data base of an available "College Information System" compatible with the mini computer selected under terms of the college's AIDP Computer Science project. (PDP11/40 hardware and WISE software were chosen.)
6) Acquisition of the additional computer memory and input/output capability necessary to take care of the needs of the Transactional Information Systems and the Management Information System.

The PME project is being carried out realistically, with the knowledge that Saint Mary's College does not have unlimited resources to effect the ultimate in planning, management and evaluation system design and operation. The top-level administrators involved in PME accepted these environmental constraints:

1) The college's present information gathering and decision making procedures must not be so disrupted as to upset required daily operations.
2) Design from scratch of a totally new, completely tailor-made Management Information System in support of PME is beyond the financial reach of the college.
3) The college's original small computer, the IBM-1130, will be kept in use and a reasonably enlarged information processing capability will be obtained by addition of a mini processing unit for time-sharing operations.

The development of a Planning, Management and Evaluation System, therefore, takes into account the college's size, financial resources, staff expertise, information needs and relative complexity. Judicious use of outside consultants, staff talent, systems analysis and available software are producing a PME System that works, rather than a complex theoretical model that never becomes truly operational.

As part of the AIDP grant application (1974-75) and Final Plan (1975-76) process, the college identified the specific elements or "products" it wished to include in its PME System. This list of elements now serves as a practical checklist for the design, implementation and evaluation of the PME System.

First of all, there are five desirable elements or outcomes in the total PME System:

1) Decision making procedures for planning, managing and evaluating college operations in relation to (a) college mission and goals, and (b) program objectives.
2) Appropriate, accurate and timely flow of information up to and down from top-level decision makers.
3) Procedures for modifying college policies and programs as required.
4) Schedule of decision points at which selected planning, management and evaluation information is required.
5) Use of annual objectives and performance measures by the five top-level administrators (the president and the vice presidents for academic affairs, administration, college relations and student development).

Secondly, nine elements define the particular outcomes or products of the

Management Information System component within the total PME System:

1) Realistic description of the kinds of information needed by top-level decision makers.
2) Planning data base of information drawn from the college's Transactional Information Systems and from outside sources (American Council on Education, American College Testing Program, Higher Education General Information Survey, etc.).
3) Programs selected from the software market and modified to meet the needs of Saint Mary's College (through College and University Systems Exchange and other sources).
4) Various summary and analytical reports to meet defined needs (such as the Financial Planning Model described below), plus an ability to generate special reports as new needs arise.
5) Timely availability of these reports for use at established decision making points.
6) Use of these reports as a basis for systematic planning, management and evaluation decisions.
7) Periodic review and modification of the Management Information System.
8) Hardware necessary to run the Management Information System.
9) Documentation of the Management Information System.

Finally, six elements pertain to the supporting cluster of Transactional Information Systems at the operational level of college management:

1) Definition of information needs and scope within each operational unit requiring data processing.
2) Systematic procedures for gathering, storing, updating,

recalling and reporting information on a day-to-day basis.

3) Capability of aggregating information to the higher level of generality required by the Management Information System.
4) Capability of faster input and output, and of real-time access to the data base.
5) Periodic review and modification of the Transactional Information Systems.
6) Documentation of each Transactional Information System:
    - Admissions Information System
    - Alumni/Donor Information System
    - Financial Information System
    - Library Information System
    - National Direct Student Loan Information System
    - Personnel/Payroll Information System
    - Student Information System

At this point, the question naturally arises, "Is PME working; is it worth the investment of time and money?" The answer is, "Yes," for the following reasons.

Because of external incentive and resources, and internal readiness and effort, Saint Mary's is able to work step by step at building an operating PME System designed for its particular needs.

The role of an outside Management Information Systems consultant is crucial in helping the college keep on schedule, in posing questions and alternatives along the way, and in offering specific professional expertise as needed. The college has the benefit of a management science consultant from a nearby state university. His prior experience and current involvement in management science as applied to educational institutions provide the necessary link between one small college and the complex galaxy of management information systems research.

The consultant relationship works because the college users retain control of the process and the consultant realizes what a college is all about:

> The participative nature of higher education decision making combines a large number of users at all three levels of decision making (strategic planning, management control and operational control). No one level is the domain of any one group of individuals. This often presents a problem in identifying an explicit decision process and the associated information needs.[3]

Once Saint Mary's had determined what elements were required in its PME System, the staff, with the help of the consultant, could select at the beginning of each academic year a reasonable number of PME-related projects to be worked on that year. The nine projects chosen for development in 1976-77 are listed in Appendix I. For each item, the person(s) responsible and the timetable of action steps are also specified, in a lengthier document not reproduced here.

One of the consultant's functions is to help the college stay on schedule. Usually, his monthly visit is the occasion for a review of the past month's accomplishments and a preview of what remains to be done. The choice of work to be done reflects the college's desire to focus on early results in using the data base, while at the same time creating a data base structure for future development.

The 1977-78 PME System Development Plan (listed in Appendix II) itemizes the projects being carried out this year, some of which are continuations of

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[3] Roger G. Schroeder, Management Information Systems for Colleges and Universities (Minneapolis, Minnesota: Management Information Systems Research Center, Graduate School of Business Administration, University of Minnesota, 1975).

1976-77 projects. Two specific items illustrate how well Saint Mary's is realizing its PME System objectives.

The first, originated in 1976-77, is the college's annual Planning and Budgeting Calendar. The current, 1977-78, calendar is reproduced in Appendix III. This calendar of deadlines or "milestones" has already proved itself to be one of the most practical tools in the PME repertory. The calendar indicates the major points at which the Board of Trustees, the administrative team (president and four vice presidents), the College Council (the college-wide advisory council to the president) and the Planning Committee are involved in preparing the annual Budget and the Planning Report. Publication of this calendar and consistent use of it by all parties concerned have been of great help in assuring the coordinated and participatory management of Saint Mary's College.

A more complicated project in the 1977-78 PME System Development Plan is the Financial Planning Model (FPM). This computer model became operational in November, 1977. A brief description of the eleven reports generated by the FPM is included in Appendix IV.

The FPM is designed for use as both a budget planning and a long-range planning tool. The basic reports display information for the three years prior to the current year (historical and audit figures), the current budget year and the new budget year to come, and three projected years beyond that - eight years all told, in a 3-2-3 configuration.

The summary of content contained in each report (see Appendix IV) indicates the nature of the data and the related input assumptions of the FPM. Now that the model is operational, the program can be changed quite readily to accommodate new variables, change the mathematical relationships and modify the report format.

At this point in time, midway through the AIDP grant period, Saint Mary's can say that its experience with the Management Information System has been immediately rewarding and is even more promising for the near future. The Financial Planning Model is being used to project various budget parameters for 1978-79 and to study the future effects of alternative assumptions about enrollment, retention, inflation, student aid, salaries, etc. The fact that the president, the chief fiscal officer and the controller actually use the model has to be a plus factor in its overall evaluation.

Office procedures in alumni/donor records and admissions have been the first to benefit from the Transactional Information Systems' being integrated with the WISE software package. Acceptance by the clerical staff and speedup of data entry and retrieval procedures are also positive signs.

As for its total planning effort, in which management and transactional information systems play a significant part, the college can report initial success in meeting these requirements of effective planning suggested by Freeman:

1) strong executive leadership and commitment,
2) clear definitions of purposes, mission and goals,
3) coordination,
4) provision for broad participation,
5) substantial financial commitment,
6) linkage of academic and financial concerns,
7) clearly defined procedures,
8) written plans,
9) flexibility,
10) comprehensive scope,
11) complete, accurate, consistent and timely information, and
12) a means of evaluating performance.[4]

The college's planning effort consciously seeks to fulfill the conditions observed in a recent study of institutions that were doing "substantive planning:"

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[4] Jack E. Freeman, "Comprehensive Planning in Higher Education," New Directions for Higher Education, Autumn 1977, pp. 47-50.

> broadness of scope, integration of decisions concerning program, facilities and budget, definition of priorities, continuous rather than sporadic activity, use of a research data base, broad participation of faculty and administrators, and emphasis on process rather than the plan itself.[5]

Certainly, this present modest success and bright hope for the future are caused in great part by a happy combination of circumstances at Saint Mary's College:

* Administrative need for, support of and use of systematic information.
* Student and faculty support of the Computer Science Department and other academic computing applications.
* Outside funding at key moments when the college was ready to capitalize on the opportunity.
* Experience with available information systems, as well as good consultant contacts.
* Someone at a sufficiently high administrative level interested in information systems and on the job long enough to make a difference.
* Someone in the computer center developing information systems applications in house from scratch and nurturing them over a long period of time.
* A computer center director knowledgeable, realistic, practical and diplomatic.

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[5] Richard C. Richardson, Jr., Don E. Gardner, and Ann Pierce, "The Need for Institutional Planning," ERIC/Higher Education Research Currents, American Association for Higher Education, September, 1977.

- A decision-making climate favoring involvement by all appropriate constituencies.
- Outside economic and political forces inspiring planning.

If all these factors are present in a given small college, information systems development will almost certainly be a positive experience.

APPENDIX I

SAINT MARY'S COLLEGE (MINNESOTA)
PLANNING, MANAGEMENT AND EVALUATION SYSTEM
1976-77 DEVELOPMENT PLAN

ITEM	PURPOSE
1. GOVERNANCE MODEL	TO CLARIFY THE GOVERNANCE AND MANAGEMENT STYLE USED IN VARIOUS PARTS OF THE COLLEGE.
2. ANNUAL PLANNING & BUDGET CALENDAR	TO INCORPORATE ALL PLANNING AND BUDGETING ACTIVITIES INTO A SINGLE, INTEGRATED CALENDAR.
3. COLLEGE PRIORITY PLANNING SYSTEM	TO IDENTIFY MAJOR COLLEGE PRIORITIES FOR THE NEXT BUDGET YEAR, AS A BASIS FOR BUDGET AND COLLEGE-WIDE EMPHASIS IN 1977-78.
4. FINANCIAL PLANNING	INSTALL AN AGGREGATE MODEL FOR PROJECTING OVERALL FINANCIAL CONDITION FIVE YEARS INTO FUTURE.
5. EVALUATION	TO CONDUCT EVALUATIONS AS PART OF THE COLLEGE GOVERNANCE SYSTEM.
6. AUTOMATION OF BUDGET SPREAD SHEETS	TO DEVELOP A METHOD FOR RAPID UPDATE OF BUDGET PLANS AND FOR FEEDBACK TO DEPARTMENTS.
7. MANAGEMENT INFORMATION RETRIEVAL SYSTEM	TO DESIGN A PLANNING DATA BASE AND TO PRODUCE THE ANNUAL PUBLICATION, INFORMATION FOR DECISION MAKING, PLUS OTHER MANAGEMENT REPORTS.

APPENDIX I (CONTINUED)

ITEM	PURPOSE
8. ONLINE ADMINISTRATIVE SYSTEM	TO INSTALL COMPUTER HARDWARE AND ASSOCIATED SOFTWARE FOR ONLINE ADMINISTRATIVE (AND INSTRUCTIONAL) COMPUTING.
9. FACULTY DATA ANALYSIS	TO ANALYZE FACULTY CHARACTERISTICS AND TO PROJECT RESULTS OF CURRENT POLICIES.

APPENDIX II

SAINT MARY'S COLLEGE (MINNESOTA)

PLANNING, MANAGEMENT AND EVALUATION SYSTEM

1977-78 DEVELOPMENT PLAN

ITEM	PURPOSE
1. PME PROCESS	TO DEVELOP AND DOCUMENT A PME PROCESS FOR SAINT MARY'S COLLEGE.
2. COLLEGE PRIORITY PLANNING SYSTEM	TO IDENTIFY MAJOR COLLEGE PRIORITIES AND BUDGET ASSUMPTIONS FOR THE NEXT BUDGET YEAR, 1978-79.
3. FINANCIAL PLANNING MODEL	TO INSTALL A COMPUTER MODEL TO PROJECT THE FINANCIAL CONDITION OF THE COLLEGE.
4. COMPUTER SUPPORT OF BUDGET PLANNING	TO REDUCE THE EFFORT REQUIRED TO PREPARE THE NEW BUDGET BY USING THE COMPUTER TO PRINT BUDGET PLANNING DATA.
5. FACULTY INFORMATION	TO IMPROVE THE QUALITY OF FACULTY DATA AVAILABLE.
6. OBJECTIVES/EVALUATIONS	TO SET SHORT-RANGE OBJECTIVES AND TO USE THEM AS A BASIS FOR ADMINISTRATION.
7. ONLINE ADMINISTRATIVE SYSTEM	TO INSTALL REMOTE TERMINALS IN SELECTED ADMINISTRATIVE OFFICES FOR DIRECT DATA INPUT AND RETRIEVAL.

APPENDIX III

SAINT MARY'S COLLEGE 1977-78 PLANNING AND BUDGETING CALENDAR -- DEADLINES

SEPTEMBER 1977

15 President & vice presidents define 1977-78 objectives.

15 College Council reviews 1977-78 budget/assumptions.

30 Department, area & program heads review their objectives, major activities & evaluation standards for inclusion in the Budget & the Planning Report.

30 Department, area & program heads present their space needs for the next three years & propose alternatives.

30 Planning Committee reviews assumptions to be included in the Planning Report.

30 College Council reviews administrative team's objectives for 1977-78.

30 Planning Committee reviews AIDP integration into the 1978-79 Budget & Planning Report.

30 College Council prepares lists of top college priorities & assumptions for inclusion in the 1978-79 Budget.

OCTOBER 1977

1 Board of Trustees receives priorities & assumptions for budget preparation.

1 1978-79 Budget request forms & instructions are distributed.

7 Board of Trustees sets guidelines for 1978-79 salaries, tuition & fees.

31 Planning Committee reviews & revises enrollment projections, policy summaries, space needs & assumptions which affect planning.

31 Academic departments return 1978-79 Budget requests to division heads.

NOVEMBER 1977

11 Division, department & office heads return 1978-79 Budget requests to president & vice presidents.

21 President & vice presidents review, revise & approve Budget requests & send them to the controller.

30 Planning Committee reviews academic & student development program objectives, activities & evaluation standards for inclusion in the Planning Report.

DECEMBER 1977

5 Controller sends 1978-79 Budget requests to the president & College Council for study.

31 Planning Committee publishes comments & questions from its review of program objectives, activities & standards.

31 Administrative team, aided by the AIDP PME consultant, diagrams the SMC Planning, Management & Evaluation process.

JANUARY 1978

9 President & College Council prepare the 1978-79 Budget for presentation to the Board of Trustees.

21 Board of Trustees acts on the proposed 1978-79 Budget.

31 Administrative team completes review of first-semester performance.

FEBRUARY 1978

28 President & College Council revise 1978-79 Budget in accord with Board of Trustees action.

FEBRUARY 1978

28 Planning Committee analyzes total college program plans & determines need for resources & facilities.

MARCH 1978

10 Faculty & staff contracts for 1978-79 are distributed.

31 Planning Committee prepares space utilization master plan for 1978-83.

APRIL 1978

1 Faculty & staff contracts for 1978-79 are returned to the president.

5 Tentatively approved 1978-79 Budget is distributed to area, division & department heads.

14 Planning Committee reviews & revises revenue & expenditure projections.

MAY 1978

12 Necessary adjustments in the approved 1978-79 Budget are submitted for Board of Trustees approval.

12 The Planning Report is presented to the Board of Trustees.

JUNE 1978

15 Administrative team completes review of 1977-78 performance.

15 Administrative team completes description of SMC PME process.

APPENDIX IV

SAINT MARY'S COLLEGE (MINNESOTA)

FINANCIAL PLANNING MODEL

OUTPUTS: REPORTS 1 THROUGH 11

NOTE: EACH REPORT COMPRISES EIGHT (8) YEARS: 3 HISTORICAL OR ACTUAL, 2 BUDGET, AND 3 PROJECTED. THUS, IN 1977-78, THE FORMAT LOOKS LIKE THIS:

ACTUAL			BUDGET		PROJECTED		
74/75	75/76	76/77	77-78	78/79	79/80	80/81	81/82

REPORT	CONTENT
1 - CURRENT FUND PLAN	DOLLAR FIGURES IN MAJOR BUDGET AND AUDIT CATEGORIES FOR REVENUES AND EXPENDITURES, USING AICPA/NACUBO TERMINOLOGY.
2 - PERCENT WITHIN EDUCATIONAL & GENERAL & AUXILIARY ENTERPRISES REVENUES & EXPENDITURES	PERCENT DISTRIBUTION IN EACH YEAR OF REVENUES AND EXPENDITURES WITHIN THE EDUCATIONAL & GENERAL CATEGORY AND THE AUXILIARY ENTERPRISES CATEGORY (NOT ACROSS TOTAL INSTITUTIONAL REVENUES AND EXPENDITURES), IN THE SAME FORMAT AS REPORT #1.
3 - PERCENT WITHIN TOTAL REVENUES AND EXPENDITURES	PERCENT DISTRIBUTION IN EACH YEAR OF REVENUES AND EXPENDITURES WITHIN TOTAL INSTITUTIONAL REVENUES AND EXPENDITURES, IN THE SAME FORMAT AS REPORT #1.

APPENDIX IV (CONTINUED)

REPORT	CONTENT
4 - ANNUAL PERCENT CHANGE IN REVENUES & EXPENDITURES	PERCENT CHANGE (+ OR -) FROM YEAR TO YEAR FOR EACH LINE ITEM, SUBTOTAL AND TOTAL UNDER REVENUES AND EXPENDITURES, IN THE SAME FORMAT AS REPORT #1.
5 - STUDENT PLAN	FIRST-SEMESTER FULL-TIME ENROLLMENT BY CLASS, MEN AND WOMEN; GRADUATE, SPECIAL, PART-TIME AND EXCHANGE STUDENT ENROLLMENT; HEAD COUNT; SUMMER ENROLLMENT; PERCENT ANNUAL CHANGES.
6 - STUDENT PLAN DETAILS	ENROLLMENT ASSUMPTIONS ARE ENTERED: NEW ENTERING FRESHMEN, PERCENT RETURN RATES FROM PREVIOUS CLASSES, NEW TRANSFERS AND READMITS TO EACH CLASS, PERCENT NEEDING HOUSING, BEDS AVAILABLE, SHORTAGE OR SURPLUS OF BEDS, SEMESTER HOURS PER STUDENT, FTE STUDENT DATA, TUITION PER CREDIT HOUR, FEES PER FTE STUDENT, ROOM CONTRACT, BOARD CONTRACT, SUMMER STUDENT CHARGES, ETC.....
7 - FACULTY SALARY PLAN	(INCLUDES COLLEGE-SUPPORTED FACULTY ONLY; NOT THOSE WHOSE SALARIES ARE PAID IN WHOLE OR PART BY OUTSIDE GRANTS). FALL FTE STUDENTS, STUDENT/FACULTY RATIO, FULL-TIME AND PART-TIME FACULTY, AVERAGE SALARIES, PERCENT FACULTY RETURNING, PERCENT ANNUAL CHANGE, ETC.....
8 - DIRECT STUDENT AID PLAN	ALL TYPES AND SOURCES OF STUDENT FINANCIAL AID: SAINT MARY'S COLLEGE, FEDERAL GOVERNMENT, STATE GOVERNMENT & OTHER SOURCES; ASSUMPTIONS ON PERCENT OF STUDENT COSTS NEEDED AS AID, AND PERCENT OF STUDENTS NEEDING AID, AMOUNT OF AID PER STUDENT, PERCENT ANNUAL CHANGE, ETC.....

APPENDIX IV (CONTINUED)

REPORT	CONTENT
9 - EXPENDITURES BY RESPONSIBILITY CATEGORIES	EXPENDITURES (IN TERMS OF PROFESSIONAL AND FACULTY SALARIES, CLERICAL WAGES, STUDENT WAGES, OTHER EXPENSE, ETC.) FOR ALL COLLEGE FUNCTIONS AND SERVICES, CLUSTERED UNDER THE FIVE CHIEF ADMINISTRATORS TO WHOM THE FUNCTION OR SERVICE REPORTS: PRESIDENT AND FOUR VICE PRESIDENTS (ACADEMIC AFFAIRS, STUDENT DEVELOPMENT, ADMINISTRATION AND COLLEGE RELATIONS); THIS REPORT DETAILS ALL THE COLLEGE'S EXPENDITURES, WHICH ARE THEN AGGREGATED IN REORT #1.
10 - AUXILIARY ENTERPRISES PLAN	DETAILS REVENUES AND EXPENDITURES FOR THE THREE AREAS UNDER AUXILIARY ENTERPRISES: FOOD SERVICE, HOUSING AND BOOKSTORE.
11 - EXPENDITURE INPUT ASSUMPTIONS	ASSUMPTIONS WHICH DRIVE THE MODEL: ANNUAL DOLLAR ADJUSTMENTS (+ OR -) IN OFFICES AND FUNCTIONS REPORTING TO THE PRESIDENT AND FOUR VICE PRESIDENTS (FORMAT SIMILAR TO REPORT # 9), ANNUAL PERCENT ADJUSTMENTS IN PROFESSIONAL SALARIES, CLERICAL WAGES, HOURLY WAGES, OTHER EXPENSE, UTILITIES AND INSURANCE, LIBRARY ACQUISITIONS, STAFF BENEFITS, ETC....., AND PERCENT DISTRIBUTION IN A GIVEN YEAR OF STUDENT WAGES ACROSS THE VARIOUS OFFICES AND FUNCTIONS.

A SMALL COLLEGE GOES ON-LINE: WHY & HOW

BY

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MUSKEGON, MICHIGAN 49442

We have a mission to provide the College with the information it needs to function in a manner that is both timely and meaningful. Both management and students depend on our ability to produce answers to their questions that are both accurate and to the point. We in turn are measured by this ability to respond when called upon. Therefore, Muskegon Community College developed a integrated, source data based, information system.

WHY?

A recent article in an educational journal reminisced about the old time registrar who was able to keep accurate records single-handedly with a "quill-pen". At the same time the article seemed to debunk the modern day computer. Not so at Muskegon Community College! The computer is alive and well. Our on-line processes have brought us into the jet age.

At Muskegon Community College, we place great emphasis on the word community. And, to the various publics we serve within our community, the watchword is service. Plain and simple, service is the key to the "WHY" regarding the Institution's decision to computerize and ultimately to go on-line.

Since 1971 the Institution has experienced phenomenal growth of almost one-hundred percent in enrollment. Growth which was triggered by the addition of key professional staff positions which placed emphasis on community outreach and service. Thus, an institutional philosophy brought students to the campus. So too, it was that same philosophy that led the way to our goal of effective, efficient service and the decision to go on-line.

One can well imagine the problems that came with this unprecedented growth in the early seventies, especially in the Admissions - Records - Student Financial areas. Long lines developed during registration. Additional days and part-time staff were added to handle the load. Work began to backlog year round.

The obvious and reactionary solution to our problems was to add full-time clerical staff. And so, staff person after staff person was added, but to no avail. This probably created more problems than it solved. Workers were sitting on top of workers, yet the backlogs continued and the long lines at registration did not diminish. The job was not getting done.

Now, we would be the last to say that the computer has solved all of our problems, but the contrast of today to just two years ago is remarkable. The long lines are gone. Registration of 5,000 students is conducted in two nights and five days with just three CRTs. Three full time clerical positions (and a host of part-time help) have been eliminated in Admissions and Records alone. Additional staff have been cut from Data Processing. In addition, office space is no longer a pressing problem. Workers have more pride in data entry since they are no longer removed from the process. Errors are at an all time low. An analysis last fall of the first 1,000 registrations showed two (yes, only two) operator errors in student scheduling. Input and updating is instantaneous.

Best of all, our students are now being served, while at the same time we are saving taxpayers' dollars. Now that you know the "why", lets' look at the "how".

We Must first assume you have a "committed" management team who want to provide better "service" and believe in use of computers to solve management problems and meet objectives. This management team should be comprised of four (4) types of people; instructional affairs, student affairs, administrative affairs, and a project manager with sound data processing knowledge. All should be willing to roll up their sleeves and get their hands dirty.

The Instructional Affairs member could be an associate dean who will be primarly responsible for all course/catalog information and class schedule information.

The Student Affairs member could be an associate dean who has the authority to schedule all events and direct personnel in the actual procedures of admission, registration, etc.

The administrative member could be the Business Manager who would be responsible for the collection of all student finances which would include: tuition, class fees, grants, scholarships, bookstore charges, fines, etc.

The project manager could be the Data Processing Manager. If not, he should be on the team. The Data Processing Manager will be responsible for all software and hardware necessary to support an "on-line" system.

Lastly, but not leastly, you need a computer which has on-line capability and software which can add records, delete records, change records and do all those house keeping chores of on-line systems without your staff having to "reinvent the wheel" again, and write all those "special programs" that the vendor won't or couldn't supply.

You then create a course/catalog file, a schedule file and start the admission of students to a student master file. Upon admission, the student can be "registered" and in the process a registration file can be created. During the registration process course/catalog information is extended and financial information collected in a student financial file. The next step is to collect financial "data", like payments, and they are applied to the student financial file.

The above files provide you the necessary basic information to carry out all of those procedures like: reporting of enrollments for state funding, billing of third parties, management of scholarships and grants, grade reporting, refunds, etc., all on-line.

Should you still be a little apprehensive about starting out on this "new venture", visit a college, like Muskegon Community College, and see the process in operation.

The College computer center consists primarily of UNIVAC 90/30, 229K memory computer. The computer has currently on-line storage capabilities of 178 million bytes and has communication terminals as well as batch processing.

The computer center serves Student Affairs (via terminals) including registration, enrollment, grading, transcripts, etc., as well as administrative support including budget, general ledger, accounts payable, accounts receivable, payroll, etc. Under the academic support we include test scoring and analysis and provide continual processing of student computer programs via terminals and batch processing in the languages of Cobol, Fortran, RPG and Basic.

We have acted as consultants for many colleges and public supported institutions. Our systems have been installed at other colleges across the country and we provide the installation team.

If additional information is desired, please contact Mike Paparella, (616) 773-9131, Ext. 364.

AN ON-LINE SYSTEM TO SUPPORT ADMISSIONS RECRUITING

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The end of the post-war baby boom and the growth of publicly-supported colleges and universities have greatly increased the pressures on the admissions recruiting officers of private institutions. The need for effective recruiting tools has grown as the competition for qualified undergraduate applicants has intensified.

The system discussed in this paper was designed to support the activities of admissions recruiters by providing information on productive high schools and geographic areas, capturing information on prospective applicants, reporting on the effectiveness of individual recruiters, and measuring the response to different recruiting methods and materials. The use of a terminal enables personnel in the Admissions Office to answer inquiries about the status of individual applications. In many ways, the system is a weapon in the war against the trend toward declining enrollment.

A college or university, if it works at it hard enough, for long enough, eventually gets to the point where the payroll is produced on time, the class lists are a reasonable representation of the students who are sitting in class, and the grade reports and student bills are somewhat accurate. After reaching this point where good information is being gathered, the next logical step is to use that information in the normal decision-making processes of the institution. The use of a computer to summarize and report the information it has gathered and processed is the logical means to achieve this step.

In many small colleges and universities, particularly in private institutions, the need for this type of management information reporting is accentuated by a tightened financial situation. Information is needed to assist in making the most effective use of current resources, rather than in planning for future growth. In addition, no large resources can be expended on gathering and manipulating this management information. The purpose of this paper is to describe a small admissions recruiting system that was designed to address these issues at The Catholic University of America.

Admissions Recruiting at Catholic University

The Catholic University of America is a private, co-educational school located in Washington, D.C.. Although the university maintains an affiliation with the Roman Catholic Church, students of all faiths and denominations are enrolled.

There are nine schools granting graduate degrees and four undergraduate schools. The current enrollment of 7,400 students reflects 2,450 undergraduate and 4,950 graduate students.

Several years ago, Catholic University realized that significant effort would be needed to combat the trend toward declining enrollment. It became obvious that the greatest effort would have to be in the area of recruiting undergraduates, particularly freshmen. Graduate recruitment is a much more difficult problem because of the "old boy" referral system, and much less financially rewarding because of the much higher cost in educating a graduate student.

Undergraduate recruiting is especially difficult for Catholic University because the potential market is nationwide rather than localized. In the greater metropolitan Washington area are private institutions such as Georgetown, Howard, Gallaudet, Trinity, and George Washington, and public institutions such as the University of Maryland, and George Mason University, as well as numerous community colleges. A high school graduate or senior who is convinced of the educational advantages of the nation's capital must then be sold on the special nature of a Catholic University education, often in spite of a higher tuition cost.

A number of other factors complicate the undergraduate recruiting problem. Among these are the lower number of potential students as the result of the declining birthrate, the increase in tuition costs, the growth of public institutions of higher education, and the variety of vocational/ checnical opportunities available. Catholic University realized that the most effective possible use of the limited recruitment dollars would have to be ascertained and that recruitment efforts would have to be concentrated on methods and areas of proven success.

It should be noted that Catholic was looking for limited recruiting tools, rather than a complete admissions system, doing such things as evaluating and recording transfer credit. The structure of the university is such that admissions requirements vary by school and the individual admissions decisions and notifications are handled by the schools, without the help of the Admissions Office. The Admissions Office consists of five recruiters, two secretaries, and a director who also functions as a recruiter. It is structured to operate in undergraduate recruiting only. Installation of a traditional admissions system would require changing the administrative structure and procedures of the university.

Origin of the System

Like many systems, the current admissions recruiting system originated from a false start. In 1974 the university contracted with a printing firm in Georgia for recruiting brochures. The printing company had excess time on its in-house IBM System-3 computer and offered, as part of the printing contract, computer processing of mailing labels for the recruiting brochures. In addition, a summary report showing the response to the various brochures was to be printed on a regular basis. There was nothing wrong with the concept of this service, however, in practice there was no benefit. Because the university would hold information until a large batch was accumulated and then ship the source data to Atlanta, and because the printing firm would wait until there was a slow processing period on its computer, the lag time between a student's expression of interest and his/her receipt of recruiting information would often be as long as ninety days.

The situation was complicated by a complete reorganization of the administration of the students records area in September, 1975. The new Director of Admissions, and the university officer he reported to, had no previous involvement with any aspect of student records. They inherited an inefficient organization and felt a great deal of pressure to increase results while, at the same time, cutting the budget. The contract with the printing company was about to conclude and there was no interest in renewing the contract, for many reasons. The Director of Admissions contacted other firms about re-designing the recruiting materials and approached the university Computer Center about a mailing label system that would also collect and summarize information on prospective students.

The computer center personnel eagerly undertook the project, for all the wrong reasons. As a result, some errors were made in the initial stages that later haunted us. Suffering from the "not-invented-here" syndrome, the computer center staff immediately set out to prove that they could quickly bring up a system that would be infinitely better than anything developed outside. The Director of Admissions was in the middle of reorganizing that office and had no prior exposure to the process of developing a computerized system. The system was therefore totally designed in the Computer Center, with very little involvement of the user. When problems arose later, they often stemmed from the user's lack of feeling of responsibility for the system. In addition, the Computer Center was in the middle of redesigning the payroll and registration systems and felt the need for the public relations benefits that could be derived from a small management information system that could be operational in a relatively short period of time. As a result, the initial versions of several reports not primarily geared to the needs of the immediate user. These problems were corrected during the first year the system was in operation, but should have been avoided by a more proper initial approach.

Goals of the System

In light of the prior experience with the computer processing by the printing firm, the primary goal of the system was to provide timely response to prospective students who had requested information from Catholic University. There was a constraint in that no large personnel or equipment expenditures could be allocated to collect the necessary information. In addition there was a need to summarize the collected information in order to evaluate the effectiveness of various recruitment methods and materials as well as to isolate productive geographic areas and individual high schools.

Of secondary benefit was the expected capability of providing the Registrar with some information on new students. Before this system, the Registrar had no idea of how many freshmen to expect at registration or who they were. His first contact with a new student was in a line at mass registration. It was expected that a side benefit of the system would be the ability to roll information on new undergraduates into the registration system, and at the same time, provide various other campus offices with the capability of contacting these students prior to their arrival on campus.

Data Collection

The first thing that had to be determined was a method of uniquely identifying prospective students. Catholic University uses social security number or an assigned permanent student number as the student identifier. A prospective student who writes or calls for an application or information rarely volunteers his or her social security number. Similarily, a student who picks up a card used to request information from a desk at a college fair or high school counselor's office might feel uneasy about providing the social security number. The only information that could reasonably be expected from the initial contact with a prospective student is name and address. A "match code" consisting of the first five characters of the last name and first four digits of the street address was devised. Thus, John Jones of 1234 Main St. would be assigned a code of 'JONES1234' and Mary Ray of 12 Elm St. would have a code of 'RAY 12'. It was recognized that duplicates could occur in the case of brothers and/or sisters or sheer coincidence, but in the two years that the system has been operating there have only been three such instances. These have been handled by the entry of a slightly altered match code for one of the students. There have also been a few cases where the stree address of a prospective student has changed between the initial and subsequent contacts. In these cases the original match code was retained.

Biographic information such as the birthdate and year of expected high school graduation is recorded. Indicators of the desired entry semester and freshman or transfer status are kept. Fields are provided to store several broad areas of interest such as engineering and arts and sciences, and additional areas are available to record interest in specific departments such as Biology and Drama. When an application is received, the date is recorded and a number of other data elements such as social security number, rank in high school class, SAT scores, and the particular undergraduate school applied to are recorded. As admissions decisions are made the status of the application is updated.

A complete list of the data elements collected through the terminal update screen is as follows;

1. Match Code
2. Name
3. Street Address
4. City, State and Zip Code
5. Sex
6. Birthdate
7. Social Security Number
8. Parent's Name
9. Name of High School
10. City and State of High School
11. Educational Testing Service Code for High School
12. High School Graduation Year
13. Freshman/Transfer Indicator
14. Semester of Entry
15. Area of Interest (2 areas)
16. Department of Interest (4 departments)
17. Code for Source of Initial Inquiry
18. Recruiter Number, if applicable
19. Application Date and Status
20. Semester Applied For
21. Recruiting Materials Mailing Flags
22. Verbal and Math SAT Test Scores
23. High School Rank in Class
24. Child of Alumnus Indicator
25. Child of Employee Indicator
26. Date Admissions Deposit Paid

Indicators for foreign students and those requesting information on financial aid and sports were originally on the terminal screen when the system was installed, but eliminated when the Admissions Office incorporated information on those subjects into the general brochure mailed to all prospective students, the mini-catalog.

Online versus Batch Update

The decision to rely primarily on online update procedures was made for several reasons. The available computer hardware, a large DEC-10 system, was a very efficient time-sharing computer, making online processing as cost-effective as batch. Batch processing would also entail a great deal of unnecessary duplication of keypunching for data such as name and address because there was no way to distinguish an initial inquiry from a subsequent request for information. It must also be admitted that there was a need to have an online capability in the student records area for various political reasons.

A batch update program was also written to convert the data collected by the system run by the printing firm to the different computer and file structures. This program was used several times when the volume of inquiries was too large to be handled by terminal input, dut to large college fails. It should be noted that when batch processing was used, the error rate was considerably higher.

The Update Process

As a student is initially added to the file, the system checks for duplicate match codes. A second index is maintained of match codes and social security numbers, to further ensure the unique identification of a student.

A single terminal screen is utilized for all online updates and inquiries. Information is logically arranged into four groupings; personal data, status indicators and information collected upon receipt of application, fields that show selected departments and areas of academic interest, and the indicators of mailed and requested recruiting materials. By special command, the terminal operator can have the cursor positioned at the beginning of one of these four groupings, rather than moving through all fields on the screen.

Several fields are automatically updated by the system. When a record is first created, the date is recorded and an indicator is set to automatically send the mini-catalog, a generalized recruiting brochure which included a response card for more specific information. There are four brochures dealing with academic areas; Arts and Sciences, Music, Nursing, and Engineering and Architecture. When a student indicates interest in general areas or a specific departments within these areas, the appropriate indicators are set to generate the requested mailings. In some cases such as a College Fair or on-campus visit, a prospective student is able to receive recruiting materials at the time that the initial contact is made. To avoid duplicate mailings of the same materials, the terminal operator will change the appropriate mailing indicators from "send" to "sent".

All mailing labels are produced in a weekly batch run, described below. A typical sequence would be for a prospective student to request information by some means such as a letter or a reuqest card from a poster in a high school counseling office. The terminal operator would assign a match code and enter the available information on the student. Within a week a mini-catalog would be mailed, giving information on general programs of study, sports, student associations, and various aspects of campus life. Included in this mini-catalog are applications to the University and for financial aid, and a request card for more information on specific academic areas.

Our typical prospective student may then mail back the response card, requesting information on Drama and Nursing. Often more biographic information is provided on this card than was available from the initial contact. The terminal operator would add any further information and add the codes for the general academic area of Nursing and the department of Drama. The prospective student would then receive brochures about Nursing and Arts and Sciences.

At some point the student sends in an application. The terminal operator enters a status of 'pending application' and any further information gathered from the application. Catholic University has a rolling admissions policy and changes in the status of the application are updated as they occur. The last entry is usually marking the receipt of an admissions deposit.

Reports and Mailing Labels

At the end of each week, a batch job is run which creates reports on the activity to date and the mailing labels for requested materials. The mailing labels are printed one per student, rather than one per requested brochure. The labels bear an indicator of the materials requested and are affixed to large envelopes if multiple brochures are to be mailed to a single prospective student. As the labels are generated the mailing indicators in the file are changed from 'send' to 'sent' status.

Detail listings are generated in this same run showing all prospective students by high school, academic interest area and department, state, and alphabetically. There is also a one-page summary report showing by source of initial inquiry, the numbers of prospective students grouped by application status. This report is used to gauge the effectiveness of different recruiters and recruiting materials.

As the system became heavily used, the need arose for a general selector program. This program can generate labels and/or lists of students selected by a number of criteria. Typical uses have been department chairmen who wish to contact students expressing interest in their departments, or the generation of labels to mail notices of orientation to students who have been accepted.

A purge program is ran once a year to transfer records that are no longer active to tape. Mailings to high schools and two-year colleges are created by a separate program that selectes requested groups from a Educational Testing Service tape of high schools and colleges.

Programs have also been written to provide statistical reports on the test scores and ranks of admitted students. Future requests for reports comparing trends between academic years or the success rate of students from different high schools are anticipated.

Results of the System

A number of changes were made in the year after the system became operational. The terminal screen was reformatted slightly for greater operator ease and a Beehive terminal was substituted for the Hazeltine 2000 originally used, due to maintenance problems.

The use of the weekly summary report allowed the Admissions Office to better evaluate the effectiveness of recruiting materials. There was an early brochure on pre-professional programs. It was found that students interested in pre-law usually also requested information on history and political science and students interested in pre-medicine requested information on biology. As a result the pre-professional information was included in the brochure on Arts and Sciences. The percentage of requests for information on financial aid was so high that that information was included in the mini-catalog, the generalized mailing.

Conversely, there were so few requests for the brochures on sports and foreign students that it was more cost-effective to add that information to the mini-catalog than to print separate brochures.

High schools were identified that generated applicants but had not had visitations, and were added to the recruiter's routes. It was also possible to distinguish between College Fairs where a lot of material was distributed with little actual results, and those that generated large numbers of applicants.

The information collected was used to involve segments of the campus community other than the Admissions Office in the recruiting effort. Department chairmen wrote letters inviting prospective students who had indicated interest in their areas to visit the campus. Notices were placed in the student newspaper before holidays and semester breaks asking students who were going home to stop in the Admissions Office for a list of prospective students from their home town or high school, that they could contact if they wished to help. These efforts were very important to an institution that emphasizes a high degree of personal contact.

All of these factors resulted in an unexpected increase in volume. The year that the system was implemented, the number of inquiries from prospective students increased from 11,000 to 20,000. This increase in volume caused problems in data entry. With an average operator time of three minutes to enter a new student, it was estimated that one terminal, used four hours per day would be sufficient. It became evident that the increased load would necessitate a full-time staff member, seven hours per day and an additional terminal will be added in the near future in anticipation of further growth.

The almost doubled volume of inquiries does not adequately reflect the total results of the system. The number of entering freshmen also increased significantly, from 594 to 922. Surprisingly, the average test scores were higher than previous years, in direct opposition to the national trend. In addition, because these new students have had greater contact with more areas of the University, it is expected that they entered with more realistic expectations and that the attrition rate should be much lower than in previous years.

In summary, the admissions recruiting system enabled Catholic University to address a larger market in a more successful and cost-effective manner. This was one case where the reality far exceeded the expectations.

COMPUTER RESOURCE SHARING: DOES IT WORK?

A case history of a Computer Resource Sharing Contract between the University of Delaware and Delaware Technical and Community College.

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This paper presents the events which lead to a contract for sharing computer resources for both academic and administrative computing between the University of Delaware and Delaware Technical and Community College. It then describes the sharing arrangement, the mutual benefits to each institution and some very significant systems and network development resulting from the contract. This includes the development of a student record system with remote processing capabilities and is operated entirely by Delaware Technical personnel. Also available is the capability to access a communications network for academic and administrative usage.

"WHY COMPUTER RESOURCE SHARING?"

The purse strings for the capital and operating budgets for colleges and universities is tightening more and more every year. Yet the costs of providing a quality education are increasing in all areas. Our colleges are facing some very difficult program priority decisions. The situation is particularly critical in decisions affecting computer resources.

Today's world, let alone tomorrow's, demands that nearly every graduating college student be exposed to computing. Over the last decade, it is amazing how computing has become an integral part of curricula which were not traditionally thought to be computer related. Obviously, the engineering, sciences, and business areas require a strong computing background, but today, historians, social scientists, and even art and music are using the computer more and more heavily and often in rather innovative ways. Another emerging instructional computing application in nearly all disciplines is CAI, Computer Assisted Instruction. Here, one-on-one, individually paced instruction takes place, but in this case, the one-on-one is computer-to-student interaction, supplemented by the instructor. It has been predicted, and indications are that it is becoming true, that the computer is going to be a household tool within the next decade.

A similar situation also exists in administrative computing. Today, higher education faces a demand for accountability for what we do and why we do it. Historically, these questions have been ignored because the answers were nearly impossible to prepare for presentation. Computers and administrative data base systems of some sophistication promise answers to these questions of accountability. Likewise, service systems and management systems of the caliber used in industry are becoming long overdue on our college campuses.

While mainframe computer hardware costs are generally decreasing, the total budget required for today's computing is not. It is simply shifting from large scale mainframes to distributed processing; from cards and EAM equipment to terminals and communication networks; from simple self-programmed applications to sophisticated software packages requiring specialized staff to instruct users and maintain the software. If anything, the budgets beg to increase enormously to keep pace with amazingly rapid technical advances.

Unfortunately, if we survey the computing resources (expenses) of most colleges and universities, we find overwhelming duplication of resources and expenses in computing. Each institution has, to a greater or lesser degree, recognized the compelling needs for computing by students, faculty and administrators. Each has channeled all the budget their institution could afford for computers, staff, and other equipment and expense. The result, taken as a whole, is an unfortunate waste. Except for the few institutions with enough financial resource and/or the exceptionally strong commitment to computing, most colleges find themselves spending what they consider a fortune on computing, and yet they don't feel they have at all answered the demand adequately. It costs a great deal to provide the variety and depth of computing resources demanded today.

The trends in computing toward time-sharing, program libraries (SPSS, UTILITIES, GRAPHICS, etc.) and more sophisticated computer-assisted research and instruction in all areas lead to the conclusion that computing is no longer a simple demand for computer mainframes on the campus tucked away in some building basement. Instead, computing today is more a service function than a piece of machinery. The day is long gone when a sign-up sheet could serve as the medium by which computer users satisfied their requirements. Commercial time-sharing firms and large corporations have clearly demonstrated how to provide computer resources to large communities of users at low unit costs. Many colleges and universities have gone this route toward time-sharing data communications, and even distributed processing. But most colleges cannot afford to establish their own network. Nor do they have the technical staff to do it. They have the need, but not the means. Some may have tried commercial network services, but many have not found these alternatives suited to their unique requirements.

Why not resource sharing between institutions with basically the same requirements? It has been done. First, let's spell out what the potential advantages are likely to be. Basically, they stem from economies of scale:

1. Computer mainframe expense - obviously more mainframe (CPU power, memory, and peripheral equipment) is potentially available if the computer expense is shared.
2. Communications equipment and terminals - savings stemming from the sharing of other expenses can be spent on the delivery of computing via keyboard terminals, communications hardware and lines, and remote input/output peripherals (readers, printers, etc., in the form of RJE's).
3. Software libraries - like the mainframe expense, the cost of developing and of purchasing software packages can be shared.
4. Specialized technical staff - in communications networking, system software support, and consulting services to the network users are a necessity and a very costly and scarce resource today.
5. Professional programming and instructional support staff - unlike the decreasing cost phenomena in hardware, this resource is increasing in cost in all areas. The programming is becoming more and more complex and a greater share of the total computing expense for almost all areas.
6. Computing management and operations - while this item is last on this list, it may well deserve to be first in terms of importance for success of any network. The sharing of this expense may cause it to occur, where before, little or no management was truly exercised over computing resources.

"REACHING DIFFICULT DECISIONS"

It is interesting that two institutions of higher learning in the State of Delaware both reached decisions about their computer resource requirements at about the same time and quite independently of each other. The decisions were prerequisites for the establishment of a computer resource sharing contract between the two insitutions via a sophisticated computer network across the State.

The first decision or, more accurately, realization was made by the University of Delaware Computing Center (UDCC) some years ago. After years of endless arguments about the "best" computer hardware to serve the University's computing needs and endless input by vendors, committees, and user groups, it was clear that there was no "best" single machine or machines. Instead, the University realized that some machines do certain types of computing better than others and that every year even better hardware and software becomes available and, indeed, more cost effective. The search for the "best machine or machines" was not a one-time exercise, but a continuous process. The UDCC has, since that realization was made, changed its orientation toward developing a data communications network, software libraries, and services. It is now a given that the hardware will change. The greater problem is delivery of services; some of these services are special purpose; some are general purpose. To this end, the

UDCC upgraded its existing main computer and, in addition, they purchased several time-sharing machines as well. At the same time, a communications network and supporting software on several machines has been developed. The UDCC looks on this array of computers and the network as one large logical machine constructed of many specialized submachines with increased levels of computational ability, where each system is the "best" for the tasks assigned (see Figure A).

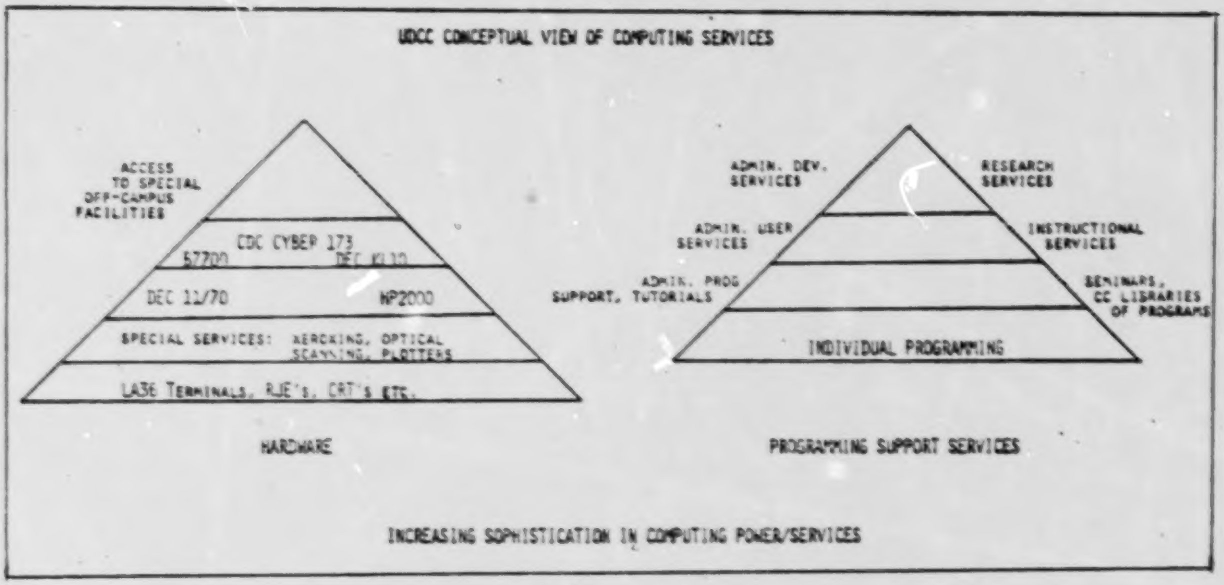

UDCC CONCEPTUAL VIEW OF COMPUTING SERVICES
ACCESS TO SPECIAL OFF-CAMPUS FACILITIES
CDC CYBER 173
57700
DEC KL10
DEC 11/70
HP2000
SPECIAL SERVICES: XEROXING, OPTICAL SCANNING, PLOTTERS
LA36 TERMINALS, RJE's, CRT's ETC.
HARDWARE
ADMIN. DEV. SERVICES
RESEARCH SERVICES
ADMIN. USER SERVICES
INSTRUCTIONAL SERVICES
ADMIN. PROG SUPPORT, TUTORIALS
SEMINARS, CC LIBRARIES OF PROGRAMS
INDIVIDUAL PROGRAMMING
PROGRAMMING SUPPORT SERVICES
INCREASING SOPHISTICATION IN COMPUTING POWER/SERVICES

Figure A

The UDCC has accepted the fact that the life span of any submachine of the network is most likely short. The UDCC's staff have made corresponding changes. The organizational units are becoming more specialized functionally. For example, there is a data communications group, a hardware and terminal maintenance group, etc. In the instructional, research, systems software, and administrative areas, the goal is to develop the needed specialized staff to foster and assist campus and off-campus users to utilize the resources best suited to the task. Correspondingly, the UDCC realized that it cannot afford to provide every possible service locally through the network. The UDCC encourages use of non-university facilities when local capabilities are not suitable. For example, through the network we have on many occasions used outside facilities and specialized computers.

At the same time, the realization that the UDCC cannot hope to foot the bill alone for its goals in computing made the UDCC seek sharing arrangements and outside financing for projects of common interest.

The second decision or, again more accurately, realization was made by Delaware Technical and Community College (DTCC) at about the same time. DTCC realized that with limited funds for computing it could not hope to provide the kinds of computing resources wanted in their instructional and administrative areas. DTCC reached the very difficult decision concerning its northern campus that the computer installed was not only too expensive, but at the same time grossly under-utilized. DTCC lacked, most critically, staff or money to provide a staff who could adequately maintain, operate or even hope to improve local facilities to meet their needs. Through foresight in its management, DTCC initiated a search for a network alternative between its several campuses. A coordinator for computing services was hired to initially establish a goal of acquiring a host computer (or service) and a network to provide computing resources to its several campuses. DTCC was aware of the staggering costs involved in this plan for hardware, staff, operation and management.

DTCC decided to look for a turn-key approach considering its limited in-house capabilities. Vendors were solicited to bid on a turn-key approach to DTCC's requirements, but most were reluctant to do so. When the bids were received, only two vendors, DIGITAL and PRIME, had responded. Both of these vendors bid only on the on-site hardware. A short story about a conversation with an unnamed hardware vendor will clarify the in-house capability to achieve DTCC's goals.

At the President's Office of DTCC there was a computer coordinator and one part-time systems analyst/programmer. In a conversation with a computer vendor, he asked about DTCC's staff. When he heard, he laughed out loud. By the time he recovered, he realized that he should not have done that, but at the same time, he confirmed our opinion that DTCC did not have the capability to implement the plan without a turn-key approach. Also, if DTCC opted for an on-site computer, it would have little ability to run it. DTCC thanks that vendor to this day for helping to avoid some bad mistakes.

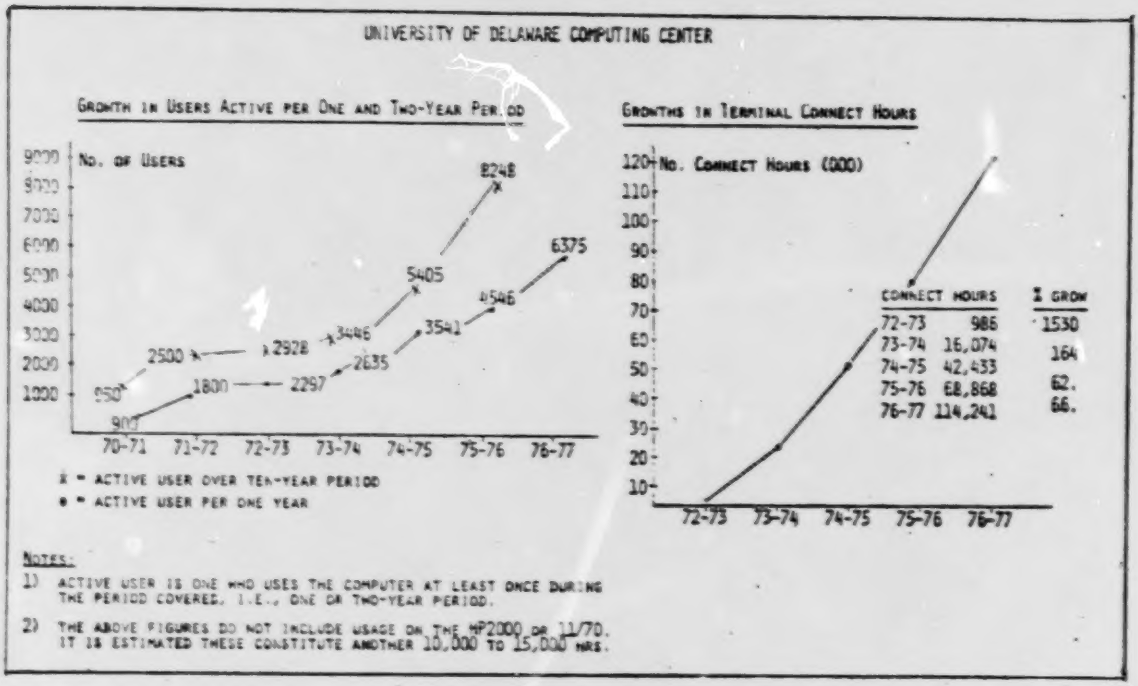
When the University of Delaware and Delaware Technical and Community College crossed paths, it was an apparent match. The UDCC proposed that DTCC join them in an educational computer network.

UNIVERSITY OF DELAWARE BACKGROUND

The University of Delaware is a land grant university located in Newark, Delaware. It serves a student body of approximately 20,000 students, 12,500 of whom are full-time day students. The University offers degree programs from associate through the PHD and post-doctoral level in a broad range of disciplines. The total annual operating budget of the University last year was over 75 million dollars, of which approximately 2.1 million dollars was the UDCC budget. The University budget is a mixture of public and private monies with about 1/3 of [illegible] funding from tuition, 1/3 from state funding, and another 1/3 from endowment and other income.

Computing at the University has shown phenomenal growth, [illegible]. In the early 70's, the University obtained [illegible] equipment capable of supporting a time-shared, multi-programming environment. Since then, growth in terms of active [illegible] departmental research and instructional projects, [illegible] have all grown at almost exponential rates. On all measures of utilization (CPU hours, [illegible] hours, jobs [illegible]) the computer has fast become [illegible] of instructional, research, and administrative programs and operation.

Figure B displays the very rapid growth in computing from fiscal 1971 to 1977 in terms of active users and connect hours. Today a normal day for the B-7700 computer posts 2,500 jobs completed per day. That machine alone has performed as many as 3,900 jobs in a single day.



CONNECT HOURS		% GROW
72-73	986	1530
73-74	16,074	164
74-75	42,433	62.
75-76	68,868	66.
76-77	114,241	

NOTES:

1) ACTIVE USER IS ONE WHO USES THE COMPUTER AT LEAST ONCE DURING THE PERIOD COVERED, I.E., ONE OR TWO-YEAR PERIOD.

2) THE ABOVE FIGURES DO NOT INCLUDE USAGE ON THE HP2000 OR 11/70. IT IS ESTIMATED THESE CONSTITUTE ANOTHER 10,000 TO 15,000 HRS.

Figure B

The cost to provide computing resources in support of this growth has also increased, but not nearly as rapidly as usage.

Figure C shows the effect of increased outside income to the UDCC from various sources including sponsored research, DTCC and other projects. It is an explicit goal of the UDCC to continue to provide more computing resources and service in response to the demands for such without necessarily requiring proportionately greater budget contributions by the University alone.

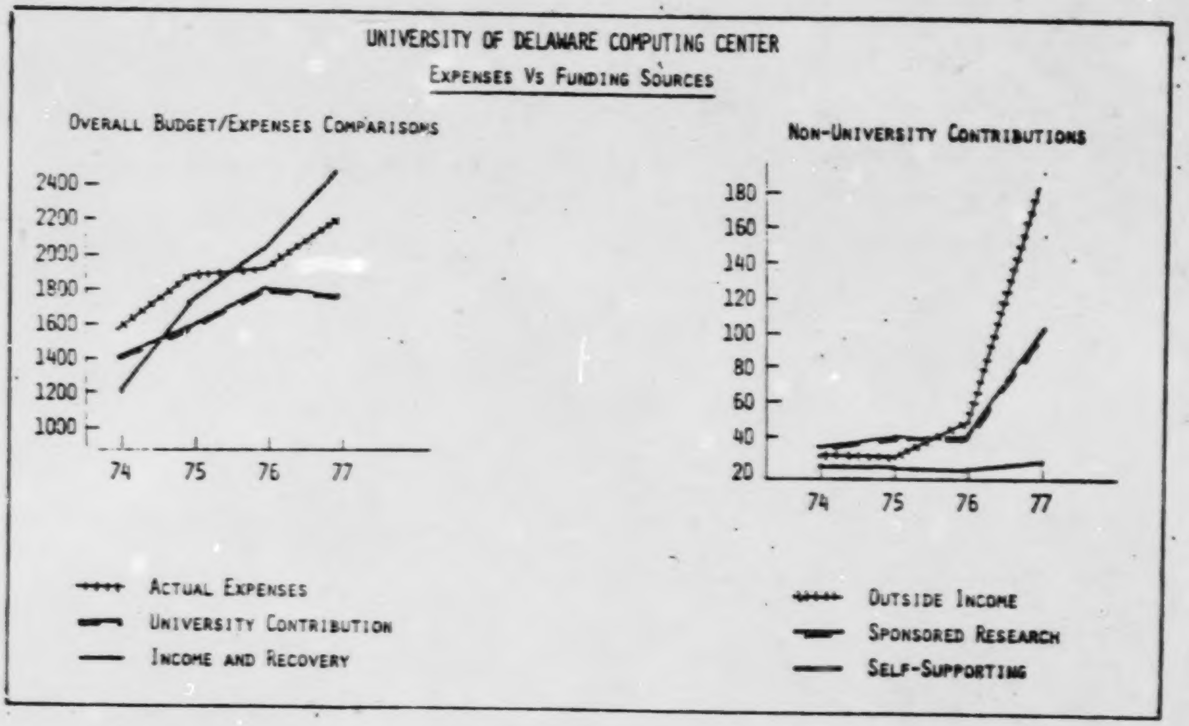


Figure C

This rapid growth has caused the University to carefully consider the UDCC's role in relation to University goals and success as an institution of higher learning. The following is quoted from the Planning Document prepared by the UDCC last year stating its goals and some of its philosophy:

Goals:

To provide a computer system and related services which optimally support:

1) the instructional process in the University
2) the state-of-the-art techniques in research

3) the complex administrative decision-making of a contemporary university
4) the surrounding region with useful, academically related computing services on a cost-sharing basis

Philosophy:

That no one computer can satisfy all the needs of a complex environment, but to economically achieve the benefits of several functionally specific computers requires a critical mass

or

One computer could do one job very well, but in order to afford it, you need to have several jobs to do.

In pursuit of these goals, the UDCC has added, in the last year and a half, three (3) more general purpose time-sharing computers: a DEC-10, a DEC 11/70, and an HP2000. In addition, the primary batch and administrative computer, the B-6700, was upgraded to a B-7700. A new building to house these computers was sorely needed to eliminate environmental problems which had caused frequent interruptions in services. The new building was designed to solve air-conditioning, electrical power, telephone, space and staff office deficiencies which had for years restricted operations. Another major addition is due next month, a CDC CYBER 173 computer, which will be used primarily to support the PLATO project for Computer Assisted Instruction.

Per the philosophy stated earlier, there is a required critical mass. The University actively pursued a computer resource sharing contract with other educational institutions in the State of Delaware. Approximately two years ago, the University learned of DTCC's search for a solution to their computer requirements. The match between the institutions was recognized very quickly by both institutions, and the contract was awarded to the University of Delaware on April 30, 1976 through the normal state agency bidding process. The University's proposal in response to DTCC's request for proposal was accepted over several bids from hardware vendors. Basically, the University's proposal was to provide computer services through a data communications network of RJE's and terminals, with the host computer at the University. The tone of the proposal was to treat DTCC as though they were a very large department of the University of Delaware with no better nor worse service than a local department might expect from the Computing Center. No special considerations were made except that the hardware and programming staff support would be costed on a full recovery basis. In addition, the University would work very closely with DTCC personnel to redesign and develop a student records system for their use through the network. The UDCC sought this opportunity to redevelop the student records system as a proprietary program product and also as a model for the University's own future use.

DELAWARE TECHNICAL AND COMMUNITY COLLEGE BACKGROUND

DTCC is a community college system with four (4) campuses across the State of Delaware. It offers up to a two-year associate degree in a broad range of technical and career areas, including: Business, Nursing, Data Processing, Criminal Justice, Electronics, Transportation, Dental, Engineering, etc. The student body ranges from 4,000 - 7,000 full-time students and another 4,000 - 7,000 part-time continuing education students. The total annual budget for the institution is about 12 million dollars per year, nearly all of which is State funded. DTCC has a very nominal tuition fee policy. The total computing budget is about $300,000 per year, which does not include DP instruction departmental expenses at the three campuses now offering that curriculum.

Prior to the resource sharing contract with the University, there were two computers located on DTCC campuses basically in direct support of the DP curricula at those campuses, plus administrative applications. The northernmost campus, Wilmington, had an IBM 370-115 computer which was removed when the resource sharing contract was entered. It was replaced by a remote job entry (RJE) terminal and two (2) keyboard terminals linked to the University computers via data comm lines. At the Stanton campus, also located in the northern part of the State, the only computer terminal which had existed at any campus was replaced by another RJE and two (2) keyboard terminals also linked to the host computer at the University. The older terminal had been tied into the computer at the Wilmington campus for the sole purpose of data entry and limited reporting in the student records area. These two campuses, Wilmington and Stanton, and the hardware changes described comprised the first phase of the contract.

The second phase of the contract was rescheduled to occur before even a single semester (quarter) had passed. In this phase, a third RJE plus two (2) keyboard terminals were installed at the Terry campus in Dover. Further additions to the hardware have occurred rapidly. The Wilmington campus now has a second RJE and two more keyboard terminals. The Stanton campus has added another keyboard terminal. The Terry campus now has over ten (10) keyboard terminals and has ordered a faster printer for their RJE. In addition, the central administrative offices located adjacent to Terry campus now have a high speed (1200 Baud) keyboard terminal plus a portable keyboard terminal and access to the Terry campus RJE. Recently, the Terry Campus gained approval to offer a DP curriculum, which is in part the reason for their rapid terminal hardware growth.

The second computer, an IBM 360, located at the southern campus is still installed and operating in support of the DP instructional program there, plus various administrative applications. Since the lease is still in effect on that computer, definite plans for that campus have not been formulated yet. A study of alternatives is in progress which will objectively evaluate that campus's situation.

While too few terminals is one of DTCC's current obstacles, there are now four terminals at each of two campuses and eleven at the third. The President's Office recently added a DEC Writer III and is planning for a CRT in the near future. The President's Office has also been using a portable TI Silent 700 for the past year, and the CRT will be purchased in kit form and will be assembled by students under the direction of DTCC's electronic faculty on one of the campuses. DTCC saves money and, again, an instructional program is enriched.

The most significant single benefit of the network has been the conversion of three of the campuses to a common student records system with consistent data definition and reporting. This conversion has eliminated a great deal of confusion and has provided on-campus operation of the student records system by each campus. An immediate cost saving benefit of the system was realized at the Terry campus, where an outside computer service contract for student record processing was no longer needed.

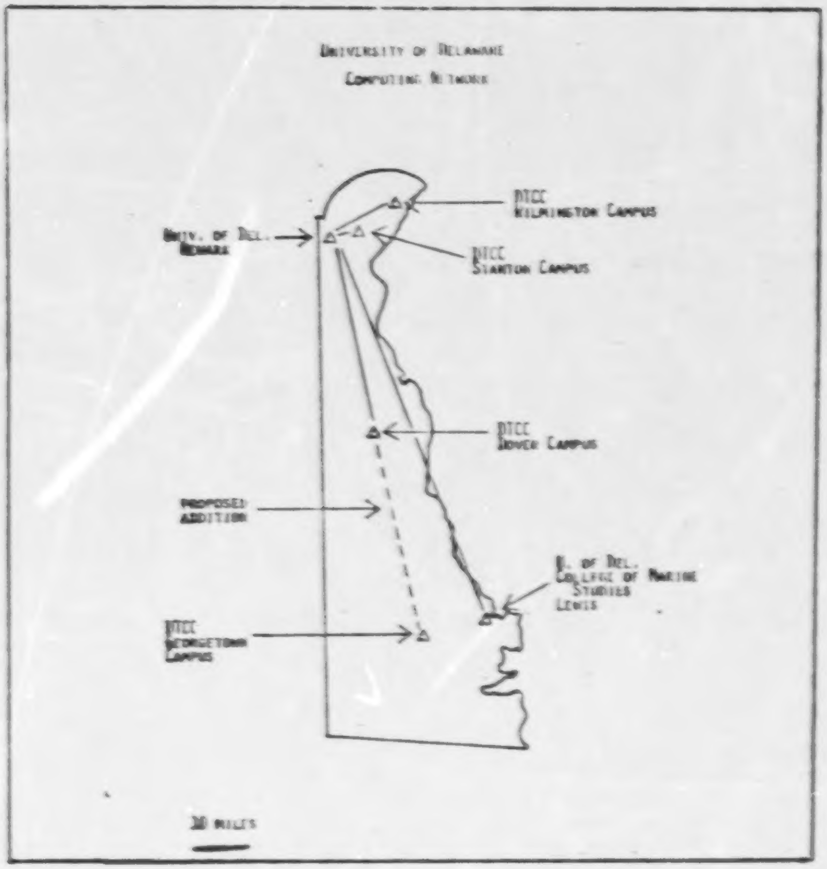
DTCC was studying their computing needs, resources and alternatives long before the resource sharing contract ever became a reality. DTCC recognized that it was unable to provide the kinds, quality, and quantity of computing resource demanded for its instructional and administrative goals. Severe under-utilization of the northern computer, in spite of the heavy demands for service going unsatisfied, was a frustrating situation. It seemed that a multi-campus network was the only solution, but that would cost more and require staffing which was not available to DTCC.

Today, DTCC is negotiating the third-year contract with the UDCC. At the same time DTCC is, with the complete cooperation of the UDCC, looking at all other alternatives for the future. DTCC and the UDCC want to be sure that their sharing contract is still the best alternative. This is a far cry from DTCC's situation less than two years earlier.

NETWORK DESCRIPTION

The University already had a network of three (3) RJE's and over 100 keyboard terminals, plotters, graphics terminals, etc. before the contract with DTCC came into existence, so that the technologies and willingness to expand already existed. Plans for a new building and additional facilities were also under way. The need for a more "critical mass" was very apparent to the UDCC in light of their goals. Since that time, the computing network which serves both the University and DTCC from one end of the State to the other has been expanded and improved into a significant educational computer network. The following is a map of the State of Delaware showing the network locations:

Figure D


UNIVERSITY OF DELAWARE
COMPUTING NETWORK
DTCC
WILMINGTON CAMPUS
UNIV. OF DEL.
NEWARK
DTCC
STANTON CAMPUS
DTCC
DOVER CAMPUS
PROPOSED
ADDITION
U. OF DEL.
COLLEGE OF MARINE
STUDIES
LEWIS
DTCC
GEORGETOWN
CAMPUS
MILES

To begin a description of the network as it exists today, we should start with the "Port Selector" located in the Computing Center at the University's main campus in Newark. The "Port Selector" is a cluster of Infotron switching equipment through which nearly all incoming telephone lines to the several computers are routed. By dialing a single phone number, a network user at a remote terminal location can select any one of the four (4) computers at the Center, a DEC-10, B-7700, DEC 11/70, or the HP2000. The "Port Selector" switches the incoming call to the appropriate computer regardless of line speeds, based on a single digit entered by the user. The word

"HELP" or unrecognized responses to the port selector causes it to switch the line to a HELP function on the DEC 11/70 computer. Currently, the port selector can handle 256 lines in and out to one or another computer.

Three of the four computers have high speed communications lines between them. For example, the DEC 11/70 monitors the B-7700 at 15-minute intervals and performs a time-share response time sequence of tests, the results of which are stored on the 11/70 and analyzed daily. Data file and even job transfers are now available between the DEC-10 and the B-7700 computers in an experimental mode. This feature should be fully operational by this spring. By next January, there will be over 320 computer ports into the four, and soon five, computers at the UDCC.

The B-7700 computer is the primary batch, administrative, and RJE computer. Currently, there are nine (9) RJE's connected to it, four (4) of which are located at DTCC campuses. Proposals exist for an additional eight (8) RJE's. Software development work is in progress to allow RJE users to forward jobs to the other computers through their RJE and also to have their output returned to the same or a selected RJE in the network. The ability to direct printed output on the B-7700 to any RJE is already a heavily used feature by all time-sharing users.

Figure E is a schematic diagram of the network:

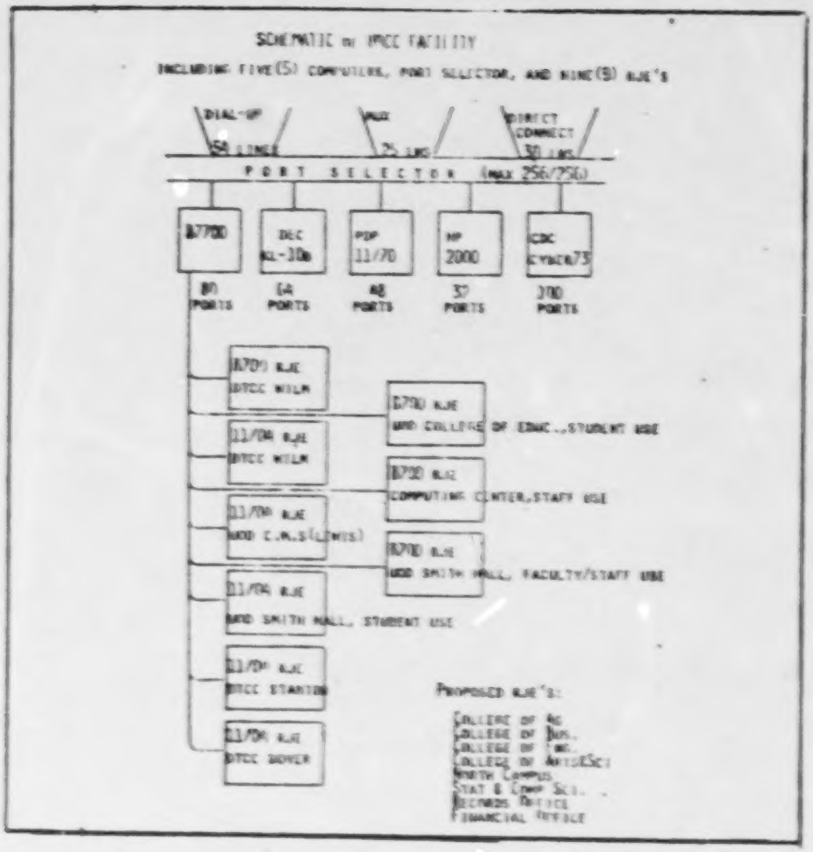

SCHEMATIC OF UDCC FACILITY
INCLUDING FIVE (5) COMPUTERS, PORT SELECTOR, AND NINE (9) RJE'S
DIAL-UP
58 LINES
MUX
25 LNS
DIRECT CONNECT
30 LNS
PORT SELECTOR (MAX 256/256)
B7700
DEC KL-10B
PDP 11/70
HP 2000
CDC CYBER 73
80 PORTS
64 PORTS
48 PORTS
37 PORTS
100 PORTS
B700 RJE
UDCC WILM
B700 RJE
WRD COLLEGE OF EDUC., STUDENT USE
11/04 RJE
UDCC WILM
B700 RJE
COMPUTING CENTER, STAFF USE
11/04 RJE
WRD C.M.S (LEWES)
B700 RJE
WRD SMITH HALL, FACULTY/STAFF USE
11/04 RJE
WRD SMITH HALL, STUDENT USE
11/04 RJE
UDCC STANTON
11/04 RJE
UDCC DOVER
PROPOSED RJE'S:
COLLEGE OF AG
COLLEGE OF BUS.
COLLEGE OF ENG.
COLLEGE OF ARTS&SCI
NORTH CAMPUS
STAT & COMP SCI.
RECORDS OFFICE
FINANCIAL OFFICE

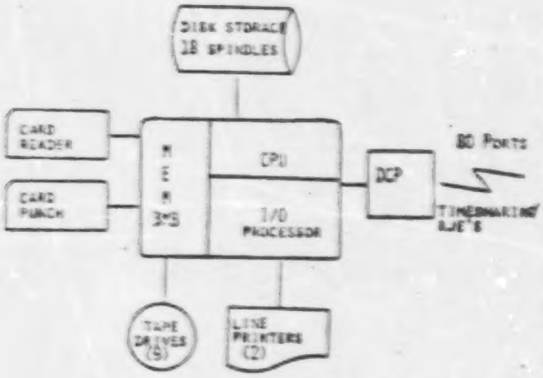
Figure E

On the following pages the configurations of the several computers in the network plus a representative RJE configuration is shown. The DEC 11/34 is used as a software development computer at the UDCC to develop improvements to the DEC 11/04 RJE operating system. We also use Burroughs B-700 computers as RJE terminals in four of the existing locations running with standard Burroughs software. It is our intention to develop a DEC 11/34 into a dual purpose RJE for instructional use where the 11/34 performs some program compilations and simple program executions locally (WATFOR, WATBOL Compilers). All other jobs would be forwarded to the host computers in the network for processing. At this time, the exact configuration for the CDC CYBER 173 is not firm, so it is not included.

CONFIGURATION

QUANTITY	DESCRIPTION
1	CENTRAL PROCESSOR*
1	I/O PROCESSOR
1	MAINT DIAG PROCESSOR
1	512K (48-BIT) WORDS MEMORY-PHASED PLANAR MEMORY
1	300 CPM CARD PUNCH
1	800 CPM READER
2	1800 LPM LINE PRINTER
9	240 KB MAG TAPES 1600 BPI
1	DATA COMM PROCESSOR (DCP)
5	ADAPTER CLUSTERS
80	DATA COMM LINE ADAPTERS
3	DISK PACK SUBSYSTEMS 1.8 BILLION BYTES - 6 PORTS

BURROUGHS B7700


DISK STORAGE
18 SPINDLES
CARD READER
CARD PUNCH
M
E
M
3*S
CPU
I/O PROCESSOR
DCP
80 PORTS
TIMESHARING/ RJE'S
TAPE DRIVES (9)
LINE PRINTERS (2)

THE PRIMARY BATCH, ADMINISTRATIVE, AND RJE COMPUTER

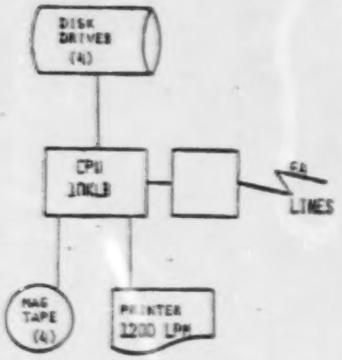
*SYSTEM IS EXPANDABLE TO 4 CPU's AND 4 IOP's

Figure F

CONFIGURATION

DEC KL10B - 1090

Quantity	Description
1	DEC-10KLB Processor With 512K (36 bit) Words
1	1200 LPM Printer
1	300 CPM Reader
4	120 KB Mag Tape Drives 75 ips
4	Disk Pack Drives 800 Million Bytes
64	Asynchronous Communications Lines


DISK DRIVES (4)
CPU 10KLB
64 LINES
MAG TAPE (4)
PRINTER 1200 LPM

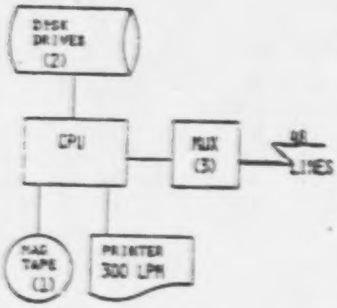
THE PRIMARY ACADEMIC TIME-SHARING COMPUTER

Figure G

CONFIGURATION

DEC PDP 11/70

Quantity	Description
1	11/70 CPU
1	300 LPM Printer
1	Mag Tape - 45 ips
2	Disk Pack Drives 200 Million Bytes
3	16 Line DH-11 MUX (48 Lines)


DISK DRIVES (2)
CPU
MUX (3)
48 LINES
MAG TAPE (1)
PRINTER 300 LPM

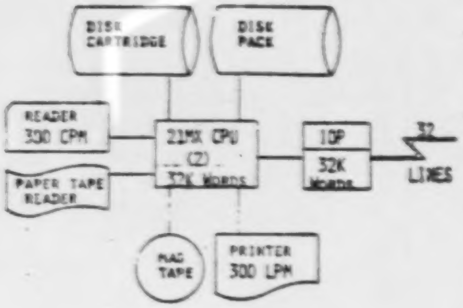
STUDENT/FACULTY TIME-SHARING COMPUTER

Figure H

CONFIGURATION

Quantity	Description
2	21MX CPU's With 32K Words Memory
1	Mag Tape - 75 ips
1	300 LPM Printer
1	300 CPM Reader
1	300 CPS Paper Tape Reader
1	Disk Cartridge - 15 Million Bytes
1	Disk Pack - 23 Million Bytes
32	Asynchronous Data Comm Lines

HP2000 ACCESS SYSTEM


DISK CARTRIDGE
DISK PACK
READER 300 CPM
21MX CPU (2) 32K WORDS
IOP
32K WORDS
32
LINES
PAPER TAPE READER
MAG TAPE
PRINTER 300 LPM

BEGINNING STUDENT TIME-SHARING COMPUTER

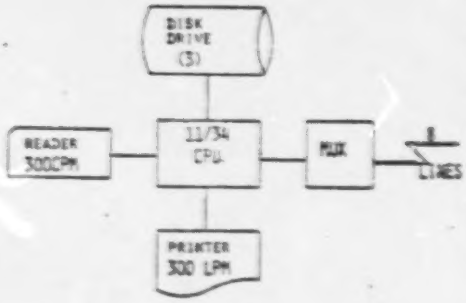
Figure I

CONFIGURATION

Quantity	Description
1	PDP 11/34 CPU 320K Bytes Memory
1	300 LPM Printer
3	Disk Cartridges - 5 Million Bytes
2	Synchronous Interface
1	8-Line MUX
1	300 CPM Reader

Operating System: RSX11, UNIX

DEC PDP 11/34


DISK DRIVE (3)
READER 300CPM
11/34 CPU
MUX
8
LINES
PRINTER 300 LPM

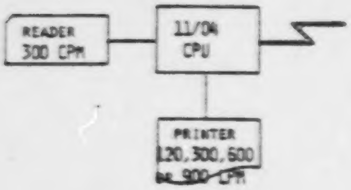
SOFTWARE DEVELOPMENT COMPUTER

Figure J

CONFIGURATION

DEC 11/04 RJE

Quantity	Description
1	11/04 CPU With 32K Memory
1	300 CPM Reader
1	Printer (120, 300, 600, or 900 LPM)


READER
300 CPM
11/04
CPU
PRINTER
120,300,600
or 900 CPM

REPRESENTATIVE REMOTE JOB ENTRY (RJE) COMPUTER CONNECTED TO B7700 COMPUTER

Figure K

"THE FRUITS OF THE EFFORT"

The benefits of the computer resource sharing contract are many and varied to both institutions. Some of the benefits accrue to both and some to only one of the institutions, as follows in outline form.

A. Shared Benefits

1. Hardware savings have accrued directly to Delaware Technical and Community College. For the cost of RJE's, keyboard terminals, and communications equipment and service alone, DTCC has acquired access to host computers which their budget could not possibly afford. Indirectly, through the sharing of processing overhead expenses, even the University of Delaware has realized hardware savings.
2. Hardware availability is increased to both institutions. This availability to DTCC is obvious; however, not quite so obvious is the same benefit to the University of Delaware. The needed impetus to fully develop the RJE software and the port selector configuration was DTCC's addition to the network. The University might still be talking about these developments and new hardware resources in their present form but for the motivation which the contract provided. In other small ways, like paying rental on disk storage, which includes a pro-rata share of the disk controllers, we have both benefitted

from greater hardware availability, even if not fully realized today.

3. Software development is a direct benefit to both institutions. The student records system represents a co-owned proprietary program product to both institutions beyond its direct functionality. In partnership, the two institutions are actively seeking a purchaser for this outstanding administrative application system. In addition, as mentioned for the hardware above, DTCC provided the needed impetus for the quality development of the network software on the RJE's and on the several host computers.

4. Specialized hardware and software support is another by-product of the contract. The University of Delaware Computing Center now has a data communications group in the software systems department where such support was not previously provided by a specialized group. In the area of hardware support, this same group is invaluable. Plans are also in progress to address the maintenance support of remotely located RJE's, terminals, and other equipment more efficiently. Again, one motivation for these plans is our commitment to DTCC, but the benefits will be experienced by main University users as well.

B. Benefits to the University of Delaware

In the short-term and definitely in the long-term, the advantage of the outside income and the contract itself to the University is and will continue to become a reality in the following ways:

1. Enables the University to acquire a richer computing environment than what it might otherwise have.
2. Presents the University to the neighboring community in a public service role of leadership and benefit to the community.
3. Increases the number of personnel, not only within a specific group (in the Computing Center), but available as inter-group resources.
4. Allows UD to implement new systems and technologies at a faster pace.
5. Provides an intrinsic value to software systems, allowing it to move forward in this area as a source of future income.

C. Benefits to Delaware Technical and Community College

The benefits to DTCC have, in many areas, been immediately experienced, and still more promise to accrue to DTCC users of the network in the future.

1. Hardware savings and availibility were mentioned before, but they are so direct a benefit to DTCC that they deserve further comment. DTCC's budget for computing was not increased by this contract, yet the hardware resources now being utilized are orders of magnitude greater than before.

2. Computer accessibility through RJE's and keyboard terminals is a new experience to most DTCC users. The network has moved the equipment right into the offices and the classrooms at DTCC, where before poorly scheduled batch mode equipment, often located off-campus, was the only computer access available to most potential users. Before the contract, DTCC's computer room was foreign turf to the other faculty. Now almost all faculty have user numbers and have been trained to use the computer. Admittedly, integration into their instructional program is proceeding at different rates depending on the individual. In any case, any one of four computers is now available to all the faculty and students.
3. A vast software library on the several host computers in the network is now available to DTCC instructional and administrative users. The library will continue to grow, independent of DTCC's resources.
4. Instructional and academic computing outside the DP curricula at the DTCC campuses is now growing. Before there was little opportunity for such growth, since the computing resources were relatively inaccessible.
5. Programming support is now available to all campuses through the network. DTCC purchases the services of one full-time programmer/analyst for student records system program maintenance and support. In next year's

contract, 1/4 man-year of an Instructional Service's programmer/analyst will also be purchased in support of academic computing.

6. Part of the first year's cost of the contract went toward a complete redesign and redevelopment of DTCC's student records system. The benefits of the new system are enormous, relative to the previous system. In a few words, the older system, at the northern two campuses, was out of control, having long before lost its program authors and a detailed understanding by user departments. It is interesting that the new system is entirely operated via RJE's and terminals by the registrar's staff at each campus, where before a member of the DP instructional staff acted as the technical liaison and operator of the system. The use of non-technical staff operating all phases of the system is daily proving that this approach is not only feasible, but also desirable. The programming and design of the entire system supports this direct user department control of its own system.
7. Management of the network is a very large benefit to DTCC. They are freed from the daily trauma of managing a complex, highly technical network and providing the support staff for that network.

"WHY DOES IT WORK?"

We have identified three (3) major contributing reasons for the success of the resource sharing contract as follows:

1. Big enough to benefit, small enough to manage
   In other words, we are better able to achieve the "critical mass" for system utilization and cost sharing with the contract. We have more and better resources between the two institutions with a more suitable utilization of those resources. There is an extreme, which obviously can be reached, where the network becomes so complex and sprawling that it would be difficult to manage. With proper management, that extreme should not be reached. In fact, at this time, the University would be very receptive to extending the network to include several more institutions.
2. Worked out by "DP" people
   The contract with DTCC was negotiated on both sides by the DP staff at both institutions. The emphasis was on providing the services required where they were needed. Very little effort was expended on contract escape clauses and elaborate protective provisions, though they were covered. There was a genuine desire to get the job done in a spirit of cooperation by the very people who knew what was

necessary and also what was unnecessary. The contract was simply a formalization of a jointly developed plan based on the University's proposal and DTCC's requirements specified in the Request for Proposal. Red tape and obfuscation was avoided by this direct approach.

3. A desire to cooperate, not mandated cooperation
   There is an unmistakable spirit of cooperation between the staff members of both institutions. The mutual enthusiasm in all our efforts to date has been gratifying to both institutions from top to bottom.

At this point, both institutions are considering a longer term resource sharing contract for the future. There are a number of hardware and communications alternatives which could only be justified in the long term that would greatly reduce costs in the network.

Both DTCC and the University would welcome inquiries concerning the network, their contract for sharing, or related questions. It is envisioned that other local institutions will be welcomed in joining the network in the future. In addition, DTCC and the University welcome inquiries about the jointly owned student records system which will be sold on a negotiated basis.

IS A DATA BASE MANAGEMENT SYSTEM FEASIBLE FOR A SMALL UNIVERSITY?

Floyd J. Burnett
Manager of Systems and Programming
Utah State University

Utah State University has embarked into the Data Base Management era somewhat motivated by the right and wrong reasons. Once committed in this direction it is not always easy to change directions; not that we want to, but we did not realize the magnitude nor hold this committment would have on future development. Utah State University now has two major systems and two minor systems running under Data Base Management. They are: Student Information System, Personnel System, Traffic and Parking System and a Program Library System. Why these systems were implemented using Data Base Management, the problems and satisfactions, what not to do, as well as what is needed to make these systems part of a larger Information System will be presented.

BACKGROUND

Utah State University is a land grant institution of approximately 9300 students (head count enrollment) located in a small rural community in Northern Utah. The curriculum at Utah State University is varied, and has extremely high quality programs in the areas of Natural Resources, Forestry, Outdoor Recreation, Agricultural Irrigation and Engineering, and Electrical Engineering, for example. It is also a heavy research institution in that approximately half of its budget is derived from either federal or other contributed funds in the area of research. To support its computing needs at Utah State University the Computer Center has a Burroughs 6700 computer with approximately 1½ million bytes of memory. This is the only computer available on campus, with the exception of a few mini computers in various research areas, and is used to support the research, academic, and administrative areas of the University.

The University is using Burroughs DMSII in support of some of the administrative applications. These will be outlined later. The University's expenditures for computing with so large a research investment is relatively small compared with many institutions. Currently hardware costs are greater than they should be for various reasons. Some maximization of our investment has resulted from having one computer serving all needs. This has also resulted in some contention between users. There is an evaluation effort underway to determine what equipment Utah State University should have to do its computing in the future as the five year lease on the Burroughs 6700 has expired. Much thinking is being given at this time to splitting computing into the traditional administrative applications on one machine and having a separate machine for research and academic purposes because of the contention that has been experienced. Having one machine has reduced hardware and support costs but not provided adequate service.

Organizationally, the computer center has reported to various organizations throughout its history. Originally, it was part of the Agricultural Research Experiment Station which helped to obtain funds from the National Science Foundation in the early 1960's for an IBM 1620 computer. As that utilization grew, it then reported to the Vice President for Research and as more users came on we progressed from an IBM 1620 to Honeywell equipment, back to IBM 360/44 and then to Burroughs 6700. Through that process the Computer Center reported to the Vice President for Research and then to the Vice President for Business during the last two years and just recently has been changed back to reporting to the Vice President for Research. As with most computing installations, they seem to attract a lot of political attention, and Utah State University has been no exception, as it (computing) has been a political football so to speak throughout its history.

"WHY A DATA BASE SYSTEM"

Utah State University recognized the need several years ago for a consistent reporting mechanism especially in the sutdent records area, as many reports were being received by agencies both on campus, and within the state and federal governments which were not consistent with each other. Therefore, a Student Record System became a priority item. As this evolved, many data base management systems were looked at. However, because of the equipment that was available to support computing, (i.e., Burroughs 6700), Burroughs DMSII became the most feasible candidate. Other considerations that affected this decision were that the data base management system from Burroughs was free as we were under a bundled contract and it looked like an excellent product. Additional motivation for data base consideration was to provide the traditional savings that a data base management system is purported to accomplish --

(1) Minimize redundancy of data

(2) Ease of Maintainability

(3) Audit and Recovery

All of these together pointed to the desirability of developing a "people" file concept which was supported at that time. In other words, if an individual is an employee of the University we can maintain basic biographical information. If he is a student, we need not carry most of the same basic information, only the additional information needs to be linked to the individual. The systems that are

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currently using DMSII are:

(1) A Student Information System, SIS, which is a comprehensive student record system covering the following areas:

Admission on-line and batch (Regular and by ACT)
Curriculum
Schedule Bulletin
Working Schedule
Registration (Pre-Registration) on-line, optical scanning or batch
Post Registration (Field House) on-line, optical scanning or batch
Drop/Add on-line, optical scanning or batch
Updates on-line or batch
Fees on-line and batch
Grades on-line, optical scanning and batch
Transcripts
Reports
Graduation Requirements
Data Base Purge

(2) A Personnel System

(3) A Traffic and Parking System

(4) A Program Library System

A brief discussion of our Student Information System (SIS) may be in order at this time. The organization of the data base is shown in Attachment #1. As can be seen this is an integrated file concept and very little data is redundant. Because of that consistency it is easier to maintain. All inputs (except registration) are on-line. Registration is not because of the need for handling large volumes in a short period of time, thus we are using a mark sense form and scanning these documents. See attachment #2 for a sample of our registration form. Admission takes place from mail or walk-in but primarily comes from ACT tapes. Attachment #3 is a sample of the acceptance form mailed directly to a student from data on the ACT tapes. Samples of other forms used are also shown as part of the section on attachments.

One may ask why these systems were put on a data base management system. A student record system is obviously motivated for the reasons of saving redundancy of data and consistency as discussed above. This was the first system to be implemented using DMSII; however, after we had limited experience with it, it became apparent that data base management system required considerable overhead and that additional utilization of that system would be more cost effective. Therefore, we determined to put up other applications more for the cost effective utilization of the data base overhead than for their own merits of requiring a data base concept. However, that is not totally true, as Personnel certainly would fall in the category of supporting a data base concept. The other reasons that prompted putting these systems up was that they were on-line. Also, the audit and recovery capability that was provided by DMS was superior to anything that we could develop locally. Finally, using the data base system increased programmer productivity for on-line systems as well.

PROBLEMS AND SATISFACTIONS

The problems which we encountered as we embarked in the use of a data base management concept were that we had not recognized initially the impact of the data base management system on our current computer configuration. It required considerably more resources than we had originally anticipated. This was aggravated by the timing of when we implemented our data base application. The student record system was not implemented until we had had the Burroughs 6700 up on campus for approximately two years. During the first two years of its existence, there was an abundance of computing power and capability. The people utilizing the system both in a time share mode and batch mode were used to getting almost immediate turnaround on everything they did. That work load had increased so that it was becoming difficult to continue to provide that service with the current configuration. The implementation of the data base management system on top of that degraded the system performance noticeably.

Therefore, all users started to point to data management as the culprit and suggested that it should not be run. Consequently, after much deliberation, additional equipment (core) was obtained to support this application. However, the University was involved in an increased work load at that time. The overall attitude towards computing and its desirability was improving, thus additional work continued to flow to the computer at an unprecendented rate. Again, within a short period of time, the same problem was back and because the data base management system was a large, readily identifiable user of resources, it again received the blame. The political situation became worse and additional equipment was harder to justify and took longer to obtain. This has been going on practically ever since and is having considerable impact on a potential decision of splitting the computing functions of administration from the research and academic functions.

Other problems were that we were a pioneer as we started with the data management philosophy, especially in terms of its early stages for Burroughs and their DMS2. Being located where we are, we had limited support from the vendor, and the people from Burroughs that supported us had absolutely no training or experience with their data management package. This left the University in an extremely difficult learning curve situation. It became quite costly and difficult for us to really do the job; however, Burroughs did provide support from either the east or west coast occasionally to review what we had done. Again, administration reviewing the project wanted results and finally as the development had drug out well over a year, additional administrative changes were made putting the center under the Vice President for Business who set time tables to complete the SIS project.

It is admitted that we were naive as we embarked on a data base management philosophy. If we were to do it over we would certainly do much the same as we have done. We would also do some things differently. One of the paramount things in most data base management systems is that it is advisable to keep it simple. We would also try to obtain some results earlier in the development of the system

Satisfactions obtained from the development of the student record system in particular, as well as others that have followed, have been thus. First of all:

- It worked.
- It does save disk.
- We have consistency in reporting.
- Provided increased service.

We have now provided a student record system that we feel is comparable to most any in the country, and serves adequately the needs of Utah State University and does it in a relatively economic fashion. We have recently gone through periods of extreme hardware difficulty where we have had considerable hardware downtime. The audit and recovery features of DMS2 have been outstanding and literally have saved the life of this system.

Audit and Recovery - What happens with audit and recovery under Burroughs DMS2 is that if there are either software operating system problems and/or hardware problems, recovery can run immediately upon overcoming those problems and all users are literally brought back exactly to where they left off. This is done within minutes from the time the system is back up and running. If the problems are serious enough to require restoring the data base to its last backup reconstruct is run and again brings the user back to where they left off. However, this may require 20-30 minutes to accomplish.

Programming to provide on-line systems is greatly reduced using Burroughs data management system and we have found that we could more effectively and efficiently develop these kinds of systems using DMS2 than we could if we were writing them without a data base management system. It is true that there is a cost associated with data base in terms of overhead, in particular, core. However, in our environment and with hardware problems that we have had and continued to have until recently, we would never had been able to survive without the complete audit and recovery capabilities and the speed and ease of doing the job that we have had with DMS.

Those on the staff who have utilized DMS prefer writing applications using it over non-DMS applications. The kind of support that is needed for Burroughs DMS is relatively small compared to other data base management systems. However, as with anything when you embark in the philosophy of a data base management system, a data base administrator is needed. We as yet do not actually have a data base administrator but that function is being filled in spite of that by a member of the staff. We are looking in the near future to formalizing that and actually having an individual specifically assigned, since he is doing it anyway, and given the responsibility officially of being a data administrator. This is necessary because data under a data base concept is not unique to any particular organization, but is shared jointly by multiple users. Therefore, it has to be controlled in terms of its use, update, and security at a different level than the traditional independent data files. The functions of a data base administrator are present with the traditional independent data files but are not as apparent as they are under the integrated, multiple user approach using data management.

This leads into the next question and that is where does the future lie?

Questions were raised in the CAUSE meetings in Florida a year ago which are valid today. I reference Cheryl Traver's[1] discussion on one large data base as something that is not feasible to a University. She questioned the advisability of one large data base, and promoted smaller independent data bases. This is a valid concern because a data base can become too big, too complex to manage. The nice things about the Burroughs data base management system is that you can effectively break it into independent parts and still treat the impact of overhead to the system. If you were to have totally separate data bases for each of the applications that we have developed, you would not be able to run them on our equipment because of the resources (core) required. So, there becomes a trade off that has to be made between the manageability of the data base and the cost of hardware, and the impact on its throughput. Rather than get into a lengthy discussion at this point as to which is the best, I would merely suggest again that you might want to read the discussion of a year ago in the CAUSE proceedings.

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[1] Cheryl Traver, et al., The Obsolescence of the University Data Base System, Proceedings of the 1976 CAUSE National Conference (Orlando, Florida, 1976)

WHAT WE WOULD DO DIFFERENT IF WE WERE TO DO IT OVER?

Several things become apparent. That is that the use of a data base management system by its nature requires a greater level of management support than if you are supporting totally independent systems. We should have involved management more heavily in that decision and obtain the support necessary for an integrated data base. They accepted the idea readily but were not prepared for the committment required to bring the various units of the University, all contending as well as supporting each other, into a collective data base and have them operate efficiently and effectively. This in and of itself is an awsome task. Without high level management support it cannot be done.

Another thing that should be done would be to better analyze the impact of a data base management system on existing hardware and to provide sufficient core in advance to be able to operate both that system as well as any other systems without the tremendous degraduation in performance that we experienced.

Another thing would be to involve more of the programming staff in the use of a data base management system, as it has become fairly well isolated today with just a few in the computer center. Of those few, we have had several of them leave which essentially has caused greater disruption than we would like in providing support and service to our users, especially those under a data base concept. In the early days of DBMS any programmer experienced in DBMS was more marketable and subject to leaving.

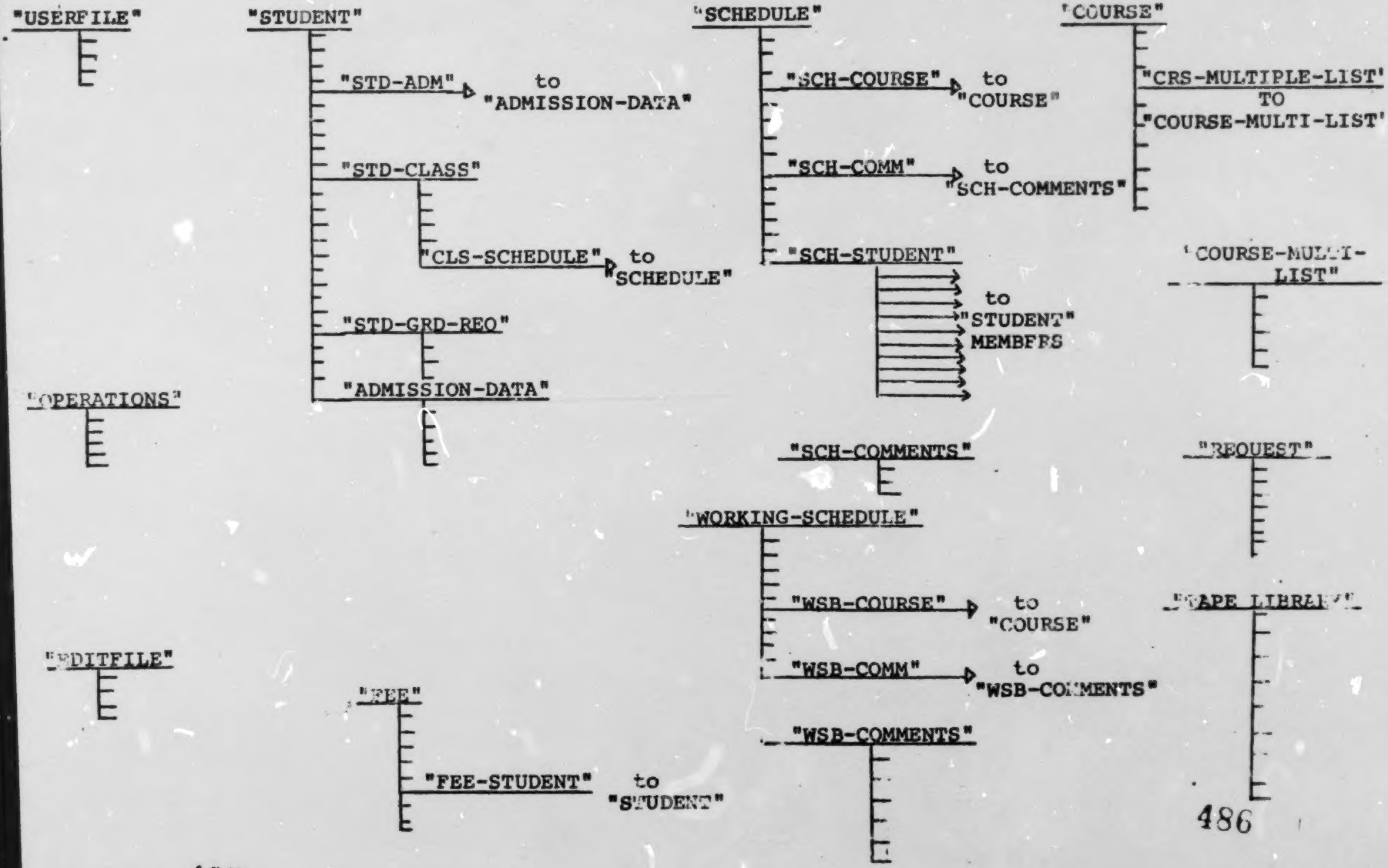
The fact that we have used a data base management system is now influencing our decision on equipment for the future because the problems of conversion are greater. The selection of a data management system that is vendor oriented makes this a more binding decision. Even then not all commerical data management systems are compatible on all hardware one may want to consider in the future. A long term committment to a particular piece of hardware is needed to justify the learning curve needed to support going into a data management concept.

Now that we are where we are and are considering other hardware the ideal solution is to be able to maintain our systems on DM while moving many of the smaller less complicated ones to mini-computers. There is an increase of programmer productivity to be found in many of these, such as the Micro-Data Reality or ADMINS systems. However, they are not the total answer and having both a large mainframe with traditional capabilities in addition to the minis is desirable.

In summary, is a data base management feasible at a small university? Certainly, but there is an investment of time and money which you have to say will be paid back by other means over a period of time. Certainly it requires a management decision that that is the correct philosophy for that University. The benefits of such a committment are also worth noting. The University has now been able to meet reporting deadlines, provide totally consistent reports, expand services to other areas and increase its budget support from the state by having accurate enrollment reports.

The battle continues for use of the computer but the results speak for themselves. The current process and procedures are well accepted by all. The problem now is to provide sufficient computer hardware to satisfy all users or to separate the functions. The continuation of our use of Burroughs DMS2 is in question because of a potential hardware change, however, it has performed well.

"USU" DATA BASE STRUCTURE


"USERFILE"
"STUDENT"
"STD-ADM"
to
"ADMISSION-DATA"
"STD-CLASS"
"CLS-SCHEDULE"
to
"SCHEDULE"
"STD-GRD-REQ"
"ADMISSION-DATA"
"OPERATIONS"
"SCHEDULE"
"SCH-COURSE"
to
"COURSE"
"SCH-COMM"
to
"SCH-COMMENTS"
"SCH-STUDENT"
to
"STUDENT"
MEMBERS
"COURSE"
"CRS-MULTIPLE-LIST'
TO
"COURSE-MULTI-LIST'
"COURSE-MULTI-LIST"
"SCH-COMMENTS"
"REQUEST"
"WORKING-SCHEDULE"
"WSB-COURSE"
to
"COURSE"
"WSB-COMM"
to
"WSB-COMMENTS"
"TAPE LIBRARY"
"EDITFILE"
"FEE"
"FEE-STUDENT"
to
"STUDENT"
"WSB-COMMENTS"

NAME

LAST	FIRST	INITIAL	LOCAL PHONE	RESIDENT STATUS	ACT SCORES MATH. COMP. ENG.

LOCAL ADDRESS

STREET	CITY	STATE	ZIP CODE	PARENT'S PHONE	DATE OF BIRTH MO. DAY YR.	MARITAL STATUS	SEX

NAME AND ADDRESS OF PARENTS OR SPOUSE

REGISTRATION FORM

AUDIT	INDEX NUMBER	DEPARTMENT	COURSE NUMBER	SEC.	CREDIT HOURS	MON.	TUES	WED.	THURS	FRI	SAT	TIME OF DAY	BUILDING AND ROOM	CLASS LIST INITIALS

DO NOT WRITE IN THIS SPACE

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GEN. REG. (OR ACADEMIC DEAN IF TAKING OVER 19 HRS.)
SIGNATURE

IF TAKING OVER 8 COURSES, MARK HERE. OBTAIN A SECOND SHEET FROM THE OFFICE OF ADMISSIONS AND RECORDS ☐

ENROLLED IN TEACHER CERTIFICATION PROGRAM? ☐

HONORS PROGRAM? ☐ MARRIED ☐ SINGLE ☐

HAVE YOU SOUGHT ACADEMIC ADVISEMENT ☐ YES ☐ NO

UTAH STATE UNIVERSITY

USE NO. 2 PENCIL

ADD ☐ AUDIT ☐ DROP ☐

INDEX NO	0	1	2	3	4	5	6	7	8	9
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ADD AUDIT DROP

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ADD ☐ AUDIT ☐ DROP ☐

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ADD AUDIT DROP

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ADD ☐ AUDIT ☐ DROP ☐

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ADD AUDIT DROP

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ADD ☐ AUDIT ☐ DROP ☐

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CREDIT HOURS		1	2	3	4	5	6	7	8	9
10										

ADD AUDIT DROP

INDEX NO	0	1	2	3	4	5	6	7	8	9
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	0	1	2	3	4	5	6	7	8	9
UNDER 10 CREDIT HOURS		1	2	3	4	5	6	7	8	9

UTAH STATE UNIVERSITY REGISTRATION PAYMENT

STUDENT'S NAME __________
STUDENT S.S. NUMBER __________
LOCAL ADDRESS __________
____
LOCAL PHONE __________
CLASS RANK __________

THIS CARD NOT VALID FOR ACTIVITIES. PRESENT THIS RECEIPT AT ROOM 8 OLD MAIN BLDG. FOR PREPARATION AND ISSUANCE OF STUDENT IDENTIFICATION AND/OR ACTIVITY CARD IF APPLICABLE

THIS U S U FEE CARD MUST BE PRESENTED IN CASE OF REFUND

DO YOU WISH HEALTH AND ACCIDENT INSURANCE FOR:

STUDENT SPOUSE FAMILY

A DOLLAR WILL BE CHARGED FOR EACH DUPLICATE FEE RECEIPT.

1			NON RESIDENT REG. AND TUITION
2			RESIDENT REG. AND TUITION
3			OTHER FEES NURSING
4			LATE REGISTRATION $10 $20
5			SPECIAL STUDENT NR 1 2 3 4 5 6 7 8 9
6			SPECIAL STUDENT R 1 2 3 4 5 6 7 8 9
7			GENERAL REGISTRATION
8			REMEDIAL FEE
9			INSURANCE STUDENT SPOUSE FAMILY
10			DEFERRED FEE NOTE 1 2 3 4
11			SPECIAL 1 2 3 4 5 6 7 8 9 10
TOTAL			CODE 0 1 2 3 4 5 6 7 8 9
			CODE 0 1 2 3 4 5 6 7 8 9

FEE TOTAL

	0	1	2	3	4	5	6	7	8	9
$	0	1	2	3	4	5	6	7	8	9
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NO CHANGE INDICATOR

VALIDATION NUMBER

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	0	1	2	3	4	5	6	7	8	9

487

DO NOT FOLD OR MUTILATE-USE NO. 2 PENCIL

CONGRATULATIONS! You have been admitted to Utah State University based on information that you requested be sent to USU through the ACT program. Your registration materials will be prepared for you when you return the verification form and application fee as noted in the instructions below.

Utah State University

PERMIT TO REGISTER

1888

Date ____________

Quarter ____________

You will register as a ____________

in ____________
(college or division)

____
Director of Admissions

PRESENT THIS FORM AT
REGISTRATION TIME

INSTRUCTIONS

1. Check the information on the verification form below and make any necessary corrections and additions.
2. Sign the verification form.
3. Return the completed verification form along with a $10 application fee. This fee is non-refundable and should be submitted by personal check or money order.
4. Retain this permit to register and present it on registration day.
5. A prompt return of the verification form and application fee will facilitate your smooth entry and will assist us in making preparations for you.

VERIFICATION OF ACCEPTANCE

UTAH STATE UNIVERSITY
Logan, Utah 84322
(UNDERGRADUATE)

PLEASE PRINT OR TYPE

1. Social Security No. ______/______/______ Name ______________ (Last) ______________ (First) ______________ (Middle)

☐

2. Application is for 1 ☐ summer 2 ☐ fall 3 ☐ winter 4 ☐ spring School year ________ Date of Verification ____/____/____

3. Mailing Address ______________ (Street No.) ______________ (City) ______________ (State) ______________ (Zip Code) ☐ (City Code) Phone No. ______________

4. Permanent Address ______________ (Street No.) ______________ (City) ______________ (State) ______________ (Zip Code) Phone No. ______________

5. Name of parent or legal guardian ______________ Relationship ______________ ☐ U.S.U. Alumnus 1 ☐ YES 2 ☐ NO

6. Address ______________ (Street No.) ______________ (City) ______________ (State) ______________ (Zip Code) Phone No. ______________ (Area Code & Number)

7. Date of Birth ____/____/____ (Mo. Day Year) Male 1 ☐ Female 2 ☐ Single 1 ☐ Married 2 ☐ How long have you lived continuously in the State of Utah ________ (Mo.) ________ (Yr.)

8. Ethnic Background (required) 1 ☐ American Caucasian 2 ☐ Black American 3 ☐ Oriental American 4 ☐ American Indian 5 ☐ Spanish American 6 ☐ Foreign Student 7 ☐ Other

9. Religious Preference (Optional) 1 ☐ Baptist 2 ☐ Episcopal 3 ☐ Independent 4 ☐ LDS 5 ☐ Lutheran 6 ☐ Methodist 7 ☐ Presbyterian 8 ☐ Other Protestant 9 ☐ Roman Catholic 10 ☐ None 11 ☐ Other

10. Have you previously enrolled in USU on campus, home study, or extension classes? ☐ YES ☐ NO Give last quarter and yr. ______________ List any other name under which you have been enrolled ______________

11. List major code in which you propose to study ______________ ☐ (Enter Code from back of Application) Degree Sought ______________ (Enter Degree from back of Application)

12. Do you object to the University publishing your name, address, phone number, and class schedule information 1 ☐ Yes

13. Are you certifying or recertifying only? 1 ☐ Yes 2 ☐ No Veteran? 2 ☐ Yes 1 ☐ No

ACT TEST date ____/____/____ (Mo. Day Yr.) Where ______________

14.

	Name of School		City and State	Date of Attendance	Year Graduated		Major
High School Graduated From							
List all colleges and Universities attended							

15. I hereby certify that all statements in this application are complete and true ______________ (Signature of Student) Date ______________
(false information may result in loss of credit or dismissal)

DO NOT WRITE BELOW

Old Student No.

Action date		Action code	
Year of Entry		NFR	
Resident status		County code	
State or country code			
Class rank	Cr. Earned	Cr. Carried	Points
102			
Application			
Supplement			
Application Fee			

RFR to Dean ______________

RFR to Committee ______________

STUDENT NAME NOBODY ZERO **SOCIAL SECURITY** 529123456 **QUARTER** F **YEAR** 77
STUDENT COLLEGE BUS **STUDENT MAJOR** 20301 **CLASS** 10

COURSE TITLE	DEPT.	COURSE NUMBER	SECT	QUARTER HOURS	GRADE	POINTS EARNED
ECONOMICS II	ECON	SS201	05	5 0	A	20 0
BOWLING	PE MW	109	09	1 0	A	4 0
ELEMENTARY	L SP	HU101	03	5 0	A	20 0
CALCULUS I	MATH	PS245	03	3 0	A	12 0
TENNIS	PE MW	136	11	1 0	A	4 0

GRADES		POINTS
A	EXCELLENT	4
B	GOOD	3
C	FAIR	2
D	POOR	1
P	PASSING	0
F	FAILURE	0
W	WITHDRAWAL	0
I	INCOMPLETE	0
N	NO REPORT	0
NGS	NO GRADE SUBMITTED	
AUD	AUDIT	

UTAH STATE UNIVERSITY of Agriculture and Applied Science

GRADE REPORT

CURRENT QUARTER

OTHER	CR CARRIED	CR EARNED	GRADE POINTS	GPA
0	15	15	60	4.000

TRANSFER CREDIT

OTHER	CR CARRIED	CR EARNED	GRADE POINTS	GPA
0	15	15	55	3.236

USU CUMULATIVE

OTHER	CR CARRIED	CR EARNED	GRADE POINTS	GPA
0	15	15	60	4.000

USU AND TRANSFER CUMULATIVE

OTHER	CR CARRIED	CR EARNED	GRADE POINTS	GPA
0	30	32	115	3.594

STUDENT NAME SOMEBODY BRAIN **SOCIAL SECURITY** 528670051 **QUARTER** F **YEAR** 77
STUDENT COLLEGE SCI **STUDENT MAJOR** 80501 **CLASS** 40

COURSE TITLE	DEPT	COURSE NUMBER	SECT	QUARTER HOURS	GRADE	POINTS EARNED
FUND RIFLE MARKSMANSHIP	RE MW	110	01	1 0	A	4 0
AUTO MECHANICS FOR DRIV	IT	155	01	3 0	A	12 0
MAN'S IMPACT ON ENVIRON	GEOG	SS371	01	5 0	A	20 0
SEDIMENTARY PETROLOGY	GEOL	410	01	3 0	B	9 0
GENERAL PHYSICS	PHYX	PS113	01	5 0	C	10 0

GRADES		POINTS
A	EXCELLENT	4
B	GOOD	3
C	FAIR	2
D	POOR	1
P	PASSING	0
F	FAILURE	0
W	WITHDRAWAL	0
I	INCOMPLETE	0
N	NO REPORT	0
NGS	NO GRADE SUBMITTED	
AUD	AUDIT	

UTAH STATE UNIVERSITY of Agriculture and Applied Science

GRADE REPORT

CURRENT QUARTER

OTHER	CR CARRIED	CR EARNED	GRADE POINTS	GPA
0	17	17	55	3.235

TRANSFER CREDIT

OTHER	CR CARRIED	CR EARNED	GRADE POINTS	GPA
o	51	51	172	3,410

USU CUMULATIVE

OTHER	CR CARRIED	CR EARNED	GRADE POINTS	GPA
0	187.5	94	264	2.809

USU AND TRANSFER CUMULATIVE

OTHER	CR CARRIED	CR EARNED	GRADE POINTS	GPA
0	238.5	140	436	3.115

FROM:
UTAH STATE UNIVERSITY
TO
UTAH SYSTEM OF HIGHER EDUCATION

**** ENROLLMENT REPORT ****

SPRING TERM, 1976-77

I UNDERGRADUATE STUDENTS (CONT.)

B VOCATIONAL-TECHNICAL

1 HEADCOUNT

	LEGAL RESIDENCE					NO. OF STUDENTS TAKING:		
	RESIDENT		NON-RESIDENT		TOTAL	12 OR >	7-11	< 7
	M	F	M	F				
FRESHMAN								
SOPHMORES								
JUNIORS								
SENIORS								
UNCLASSIFIED								
TOTAL VOCATIONAL-TEC								

2 SCH AND F.T.E.

	LEGAL RESIDENCE			LEVEL	
	RESIDENT	NON-RESIDENT	TOTAL	LOWER	UPPER
SCH					
F.T.E.<SCH / 15>					

C SUMMARY OF UNDERGRADUATES

	HEADCOUNT			F.T.E.		
	RESIDENT	NON-RESIDENT	TOTAL	RESIDENT	NON-RESIDENT	TOTAL
UNDERGRADS (NON VOC)	3	9	12	2.80	9.93	12.73
VOCATIONAL-TECHNICAL				.00	.00	.00
TOTAL UNDERGRADS	3	9	12	2.80	9.93	12.73

FROM:
U T A H S T A T E U N I V E R S I T Y
TO
UTAH SYSTEM OF HIGHER EDUCATION

**** ENROLLMENT REPORT ****

SPRING TERM, 1976-77

II GRADUATE STUDENTS

A GRADUATE STUDENTS

1 HEADCOUNT

	LEGAL RESIDENCE					NO. OF STUDENTS TAKING:		
	RESIDENT		NON-RESIDENT		TOTAL	12 OR >	7-11	< 7
	M	F	M	F				
MASTERS	2		2	1	5	2	1	2
PHD (BASIC)	1				1	1		
PHD (ADVANCED)			2		2	2		
UNCLASSIFIED								
TOTAL GRADUATES	3		4	1	8	5	1	2

2 SCH AND F.T.E.

	LEGAL RESIDENCE				LEVEL			
	RESIDENT	NON-RESIDENT	TOTAL		MASTERS	DOCTORAL		OTHER
			BASIC	ADVANCED	BASIC	BASIC	ADVANCED	BASIC
SCH	21	51	40	32	31	9	32	
F.T.E. <SCH / 10>	2.10	5.10	4.00	3.20	3.10	.90	3.20	

REGULAR STUDENT

	HEADCOUNT			F.T.E.		
	RESIDENT	NON-RESIDENT	TOTAL	RESIDENT	NON-RESIDENT	TOTAL
UNDERGRADS (NON VOC)	3	9	12	2.80	9.93	12.73
VOCATIONAL-TECHNICAL				.00	.00	.00
GRADUATE	3	5	8	2.10	5.10	7.20
GRAND TOTAL	6	14	20	4.90	15.03	19.93

11/02/77

FROM:
UTAH STATE UNIVERSITY
TO
UTAH SYSTEM OF HIGHER EDUCATION

**** ENROLLMENT REPORT ****

SPRING TERM, 1976-77

III. TOTAL HEADCOUNT BY SEX

AGE	MALE	FEMALE	TOTAL
18 AND UNDER			
19 - 20	1	1	2
21 - 22	4		4
23 - 24	3		3
25 - 29	4	2	6
30 - 34	5		5
35 - 39			
OVER 40			
TOTAL	17	3	20

```
11/02/77                                                FROM:
                                         U T A H   S T A T E   U N I V E R S I T Y
                                                          TO
                                            UTAH SYSTEM OF HIGHER EDUCATION

                                         ****     ENROLLMENT REPORT     ****

                                                 SPRING TERM,  1976-77

  V. STUDENT-CREDIT-HOURS-TABLE      COLLEGE TOTALS FOR:     BUSINESS

              +--------------------------------------------+
              |              LEVEL OF STUDENT              |
              +--------+--------+--------------------------+
 +------------+        |        |         GRADUATE         |
 | LEVEL OF   |        |        +--------+-----------------+----------+
 |  COURSE    | LOWER  | UPPER  | BASIC  |    ADVANCED     |  TOTALS  |
 +------------+--------+--------+--------+-----------------+----------+
 |   1-99     |        |        |        |                 |          |
 +------------+--------+--------+--------+-----------------+----------+
 |   100      |        |        |        |                 |          |
 +------------+--------+--------+--------+-----------------+----------+
 |   200      |    10  |        |        |                 |      10  |
 +------------+--------+--------+--------+-----------------+----------+
 +------------+--------+--------+--------+-----------------+----------+
 |   300      |        |        |      4 |                 |       4  |
 +------------+--------+--------+--------+-----------------+----------+
 |   400      |        |        |        |                 |          |
 +------------+--------+--------+--------+-----------------+----------+
 |            |        |        |+-------+-----------------+----------+
 |   500      |        |        ||       ||            3   |       3  |
 +------------+--------+--------+|       ||                |          |
 +------------+--------+--------+--------+-----------------+----------+
 |   600      |        |        |     9 ||            3   |      12  |
 +------------+--------+--------+--------+-----------------+----------+
 |   700      |        |        |     3 ||                |       3  |
 +------------+--------+--------+--------+-----------------+----------+
 |  TOTALS    |    10  |        |    16 ||            6   |      32  |
 +------------+--------+--------+--------+-----------------+----------+


                  SCH            FTE
                  ---            ---

 LOWER             10          0.667
 UPPER              4          0.267
 BASIC             12          1.200
 ADVANCED           6          0.600
                -----          -----
 TOTALS            32          2.734
```

11/02/77

FROM:
UTAH STATE UNIVERSITY
TO
UTAH SYSTEM OF HIGHER EDUCATION

**** ENROLLMENT REPORT ****

SPRING TERM, 1976-77

V. STUDENT-CREDIT-HOURS-TABLE GRAND TOTALS FOR: ALL COLLEGES

LEVEL OF COURSE	LEVEL OF STUDENT				
			GRADUATE		
	LOWER	UPPER	BASIC	ADVANCED	TOTALS
1-99	3				3
100	72	9			81
200	33	3	3	3	42
300	7	17	7		31
400		17	8		25
500		9	10	14	33
600			23	7	30
700			7	11	18
TOTALS	115	55	58	35	263

11/02/77

FROM:
UTAH STATE UNIVERSITY
TO
UTAH SYSTEM OF HIGHER EDUCATION

**** ENROLLMENT REPORT ****

SPRING TERM, 1976-77

VI. DIST OF STUDNTS BY CRED HRS ENR

CREDIT HOURS TAKEN	NUMBER OF STUDENTS RESIDENT	NON-RESIDENT	TOTAL
3	0	1	1
5	2	0	2
6	0	1	1
9	0	1	1
11	1	0	1
12	0	3	3
14	1	0	1
15	1	3	4
16	0	1	1
17	0	1	1
18	0	1	1
19	0	1	1
20	1	0	1
24	0	1	1
TOTAL	6	14	20

A COST/BENEFIT ANALYSIS OF SMALL COLLEGE PARTICIPATION IN COMPUTER CONSORTIA

Paul J. Plourde
Director, Three College Computer Center
serving Amherst, Hampshire and Mount Holyoke Colleges

This paper discusses the organizational structure, policictal realities, and the problems and success of a seven-year old small college computer consortium.

A COST/BENEFIT ANALYSIS OF SMALL COLLEGE PARTICIPATION IN COMPUTER CONSORTIA

In his book on the current state of consortia in the United States, Franklin Patterson, the former president of Hampshire College, identifies the key question in consortia participation when he states, "How can institutional cooperation enable more efficient allocation of limited resources to virtually unlimited needs?" (1974, p. 31).

Since 1965, the five colleges in the Amherst area (Amherst, Hampshire, Mount Holyoke, Smith, and the University of Massachusetts at Amherst) had cooperated formally by the establishment of Five Colleges, Inc., and had established cooperative academic programs, faculty and student interchanges, a five college radio station and a five college bus service among other activities. It was with this background of cooperation that the four private colleges sought to establish a joint administrative computer center in 1970 which would have the following objectives:

1. Joint use of hardware.
2. Compatibility and comparability of basic input and storage.
3. Joint development of systems and software wherever possible.
4. Consultation and review by Amherst computer center of all systems and software developed in the four colleges (Plourde, 1970, p. 1).

The formal proposal for cooperation came from Amherst College but the germ of the idea existed in the mind of Charles Longsworth, the then vice-president of Hampshire College, Kurt Hertzfeld, the treasurer of Amherst College, and others at institutions in the valley. At the time that the proposal was made in January of 1970, the four institutions (Amherst, Hampshire, Mount Holyoke and Smith Colleges) had a wide variety of administrative computing capabilities as follows:

1. Amherst College had been operating an IBM 1401 computer system for

four years and had seen its cost increase from approximately $100,000 per year in 1966-67 to $160,000 in 1969-70 and the prospects for increased costs were substantial. Applications systems had been developed in the payroll, budgeting, course registration, grade reporting, admissions and student information areas. There was a central programming staff of four people.

2. Hampshire College was a new institution which was about to enroll its first class and was processing payroll and cash disbursements at a service bureau facility.
3. Mount Holyoke College was not processing any administrative systems by computer although they were using NCR bookkeeping machines for a few applications.
4. Smith College had a two person programming staff and was developing its own computer applications and was using the Amherst computer for its administrative processing.

There were a number of suspected advantages and disadvantages of cooperation as noted in Attachment A pages 1 and 2, and the proposal for cooperation which was presented to the presidents of the four institutions focused on five areas: financial considerations, computer power, additional applications, data exchange and analysis, and personnel. The fact that the proposal was presented at the presidential level is a critical point and as Patterson has noted, "the cooperative consortia...requires that the chief executive officers of the participating colleges and universities sit on the governing board of the consortium. Only the presidents can commit their institutions to significant academic cooperation or to other major cooperative arrangements." (p. 48). While the presidents do not sit on the board of the Three College Computer Center, they were intimately involved in the original decision to participate.

The proposal suggested that an integrated system would be developed which would pertain to the following administrative functions: financial accounting, personnel, registrar's and admissions information, alumni(ae) information, and development information. The funding arrangements proposed that each college would pay a 25% share of the systems development costs and would pay for computer utilization based on actual use. It is important to note that while the presidents were advised that there would be some financial advantages to cooperation, the proposal also noted that, "The first-year costs undoubtedly will be higher then would be the case if the individual colleges chose to proceed independently. However, over a period of years, the overall costs of the member colleges should be less." (Plourde 1970, p. 2).

Three of the colleges (Amherst, Hampshire and Mount Holyoke) accepted the proposal with minor modifications to the funding arrangements and Smith College decided to continue developing its own administrative applications and they continued to utilize the Amherst computer system until it could acquire its own computer. The eventual phase out of Smith College to its own system was accomplished in March of 1972.

Organizational Structure

There were a number of possible organizational structures that could have been selected but the structure proposed and adopted as depicted in Attachment B reflected the commitment of the computer center to the participating colleges, the necessity to schedule and coordinate the use of hardware, development of software and provide the opportunity for each college to progress at a somewhat different pace and with somewhat different priorities from the other colleges. For this reason, heavy emphasis was placed on the concept of institutional planning to identify systems development and hardware use priorities at the institutional level. As noted earlier, the presidents do not sit on the Three College Committee which serves as the board, but the institutions are represented by the treasurer and the coordinator of computer services and their function is to represent the institution in development of three college systems development priorities. This group meets on a monthly basis and in addition to the organizational structure depicted in Attachment B, there exists a Coordinating Council which consists of the coordinators and the director which has the responsibility of interpreting the needs of the three colleges on a day-to-day basis.

An important concept in the development of systems was the idea of establishing Coordinating Committees which would be appointed by the institutional planning groups as needed to work with the computer center staff in whatever areas of development were currently being undertaken to perform the following functions:

A. define the terminology to be used,

B. identify the systems requirements,

C. enunciate the needs and priorities of this particular system area to the Three College Committee,

D. assist in data element definition, and

E. assist in implementation of the computer system in its respective area.

The whole idea of the particular organizational structure was to have proirities flow downward from the institution through the Three College Committee in order to provide the director of the computer center with specific directions and thereby making him the administrator of the policies rather than the person who would determine systems development priorities as might be the case under a czar system.

In reality, the structure has worked rather well although a number of problems have developed which will be addressed below, but the concept of institutional planning and institutional representation on coordinating committees has been vital to the systems development process as well as the survival of the cooperative enterprise. The value of a number of mechanisms for intra-institutional communication as well as communication between the computer center and the institution cannot be overemphasized since the psychology of alienation can quickly set in when one is operating in a consortium.

One of the factors that was advanced for centralized systems design and development was the concept of attracting a critical mass of professional personnel who would have overlapping areas of expertise and thus providing the participating institutions with the possibility of concurrent design of systems as well as provide backup personnel that one institution acting alone could ill afford. The staff of the center over the past seven years has ranged in size from a maximum of 11 individuals in systems and development to a low of seven, but the goal has been to carry on three concurrent projects. Just as it was recognized that the budget in the initial years would be somewhat higher because of the start-up costs, the personnel requirements were greater during the first two years of the consortia's existence. Since the development of the final component of the integrated system which was the personnel/payroll system, the staff has been further reduced and the main activity will be in the area of system enhancements.

Systems Definition, Design, Development and Implementation

As noted above, the computer center staff works closely with the users on each campus through the coordinating committee structure in defining and developing systems. Each college is represented on each coordinating committee by one representative as well as the coordinator of computer services for that institution and this mechanism was adopted to provide for user input, flexibility in the systems design, commonality in data structures, and query facilities that are user-oriented.

The committees are established in ad-hoc fashion as they are needed when the Three College Committee allocates a priority for systems development in a given application area. After the initial system is designed and implemented, the committee is disbanded and reactivated in the event that a new priority is assigned for enhancement to the system.

The concept of the Coordinating Committee was adopted even though we reocngized that this process of meeting on a three college basis would be time consuming, but it was felt that in the end it would still be less expensive than each institution defining its own system independently. Aside from the resultant one system as opposed to three, the main benefit of the coordinating committee structure has been that none of the representatives has a monopoly on good ideas and the result of these coordinating efforts have incorporated important suggestions from various users.

The Reality of Cooperation - Problems

As might be expected, seven years of participation in a cooperative venture amongst three independent, private, liberal arts colleges has had its share of problems as well as successes. While some of the problems relate to technical difficulties, the major roadblocks have been in the area of what I would call the socio-political, psychological aspects of cooperation. Whereas the success of such an organization should inevitably be judged based on user satisfaction, the interface of the computer center staff with users is often a secondary concern to that of the more global issues of governance, and inter and intra-institutional politics. Often the computer center is really not the issue but is seized upon as the issue by varying factions within an institution and in that sense becomes a political football.

The organizational structure has attracted considerable attention over the years with governance and institutional representation being the key issues. Since the director reports to a committee, there is the inevitable problem of to whom he reports and whether or not all of the institutions have equal access to that individual.

The excessive reliance on committees coupled with the funneling of all requests through coordinators at the institutional level has created a bottleneck which makes it difficult at times for the computer staff to interface with users and adequately reflect their needs in the systems that are developed. At the very least, it delays the systems development process.

Aside from the governance question, the subject of systems development priorities, enhancements and user expectations receive the most attention by the Three College Committee and have caused the most problems. While the mechanisms are in place for each college to make a case for the development of a system, it is impossible to satisfy all of the members all of the time. Users who are accustomed to spending very little on administrative data processing who suddenly find themselves,as an institution, spending in excess of $100,000 rightfully expect results. The question is what can people reasonably expect to receive for such an expenditure. With the limited staff employed by the center, it is inevitable that either an institution or a user or a group of users will be dissatisfied if their particular area of concern is not addressed in the systems development schedule approved by the Three College Committee. This is especially true with immature users who have not suffered the growing pains of computing and expect that systems design and development is a rather simplified activity connected to the black box that has been purchased. Thus, they can't quite understand why it takes two years to develop a personnel/payroll system.

The location of the computer center and the fact that many of the initial systems utilized by Hampshire and Mount Holyoke originated at Amherst has been a continual problem. Ideally, the center should be located away from all the campuses but this was not economically possible. Yet, this is of little consolation to the other institutions who would prefer to have greater access to the physical center. The use of Amherst as a base for future systems development was based on the desire to get the other two institutions up and running quickly but over time this is lost on the users who would prefer to have had all of their systems developed from ground zero.

The budgeting process has not been a problem perse but has been based on a relatively fixed expenditure level especially for the computer which in retrospect was unrealistic. Budget revisions were made as a reaction to needs which is not uncommon in small colleges and certainly tends to keep expenditures at a minimum and, in that sense, this was a positive factor as will be noted below.

A user-oriented system was the goal of the cooperative venture and we have not been entirely successful in educating our users as regards the optimum use of the system. This is related in part to the alienation of the computer center staff from the users because of the requirement to channel all communications to an institution through the coordinator and the delegation of the responsibility for user education to the coordinators. Similarly, we were attempting to develop a flexible user-oriented query system for the integrated data base and we have been partially successful in this endeavor but the users still feel that the turnaround time from report request to production is too lengthy.

The mechanisms for developing systems mainly through coordinating committees has been effective in part but often coordinating committee members lack the involvement to keep abreast of developments in order that they can contribute effectively at meetings.

Finally, the organizational structure has also contributed to the development of the "pass the buck" syndrome with coordinators, computer center staff, coordinating committees and institutional planning groups, often not wishing to deal with a problem and passing it on to another group for resolution or even worse, pointing the finger at someone else as the problem source. The structure and the voting mechanism for deciding issues (where majority rules) has often intermeshed policy questions with technical decisions and has sometimes resulted in a course of action that is less advisable from a technical standpoint but is politically more palatable.

The Reality of Cooperation - Successes

Most of the hope for benefits of cooperation in the area of finance, computer capabilities, systems development and personnel have been realized, even though each of these would undoubtedly have to be measured in terms of degrees rather than in an absolute sense.

In comparison to the three institutions operating centers independently, we have been able to install and operate a computer system that provides considerably more throughput per dollar than would be the cost for three separate systems. Similarly, the cost for systems design, development, implementation and maintenance has been far less than would have been the case for three institutions operating independently and the center has operated within its budget constraints for all of the seven years for which it has been in operation.

From a systems development standpoint, we have an impressive record of systems development and implementation which has involved application areas that some of the institutions would not have tackled were they operating alone. The resultant systems are considerably more flexible and sophisticated than a typical applications system that would have been developed by a small college and on the whole, considerable effort has been spent on producing multiple levels of documentation for users, coordinators, and computer center staff which is often the last thing that is addressed in a small computer installation.

The role of the user in participation in coordinating committees has been impressive and has resulted in user-defined systems while at the same time maintaining as much commonality within the system and thus extending the cost savings to this activity as well.

From a personnel standpoint, we have been successful in attracting a highly professional staff and we have been able to develop areas of expertise which would otherwise be impossible in a typical small college installation. The concept of data base management was a vital ingredient in our early design specifications and the function of data base administration has been an integral part of the organization of the computer center staff. We have also been able to develop specialization of our analysts in various areas such as personnel/payroll and finance, student systems and alumni(ae) systems. In short, we have been able to assemble the critical mass of people which is so vital to the success of any computer center. From this author's perspective, this is a vital point since far too many small colleges insist that they can install a computer and operate with a one person staff thereby leaving themselves vulnerable to changing technology and perhaps more important, termination of a key individual.

The software sophistication that we had hoped for was realized and we were able to develop the position of a Software Specialist as well as devote some attention to the development of a query language which has been heavily used by all of the application areas. Both of these would be unthinkable in a smaller computer center and we have been able to keep our head out of the sand to look beyond application areas to develop a uniform integrated data base which revolves around a data base management system.

Finally, as suggested above, the ultimate measure of success resides in user satisfaction. While there are vocal pockets of resistance to the idea of cooperation and to the products produced by the Three College Computer Center, on the whole, even an outside observer would have to admit that user satisfaction is quite high when measured against the typical user reaction to computer centers.

Prospects for the Future

As with any entity, the computer center experiences a life cycle and goes through multiple stages of growth. When the individual institutions had relatively few systems implemented, the propensity for common development was far greater than it is presently when each institution is seeking to fine tune existing systems. In addition, the prospects of cost saving for the major developmental areas are reason enough to compromise even though as Patterson suggests in observing the consortia scene, "there appears to be no sign of natural, evolutionary development towards cooperation." (1971, p.) Although Patterson suggests that voluntary cooperation by seductive means has, as a general rule, failed in the consortia movement (p. 56), the three colleges participating in this particular consortia have demonstrated over time their willingness to cooperate, compromise and reap the benefits.

At present, the Three College Computer Center is reevaluating its future prospects and several options are open to us including voluntary dissolution of cooperation. Since the agreement for cooperation is being renegotiated, there has been some concern raised about institutional systems development with the retention of a central staff for certain types of software maintenance and development. The advantage to this arrangement as seen from the institutional point of view is to provide additional flexibility to address institutional priorities, especially in view of the fact that all of the major application systems have been developed. Another possibility is the retention of central systems and programming but the development of separate computer centers on each campus which may or may not be linked in a distributed network design. This option seems less likely than the possibility of having some decentralized programming. The third option of the total dissolution of both the centralized hardware and software capability is quite remote, since it is doubtful that any of the colleges acting individually could cost justify this action either in terms of dollars saved or improved service.

References

Patterson, Franklin. Colleges in Consort. San Francisco: Jossey-Bass 1974.

Plourde, Paul J. "Four College Computer Center Proposal," Internal paper presented to the President's of Amherst, Hampshire, Mount Holyoke and Smith Colleges, January 7, 1970.

ADVANTAGES OF COOPERATION

FINANCIAL

SHARED COSTS FOR:
- SYSTEMS DESIGN
- PROGRAMMING
- COMPUTER OPERATIONS

TECHNICAL

- LARGER COMPUTER
- MORE THROUGHPUT PER DOLLAR
- GREATER APPLICATIONS DEVELOPMENT POSSIBILITIES

PERSONNEL

- SIMPLIFIES ATTRACTING QUALIFIED PERSONNEL
- PERMITS DEVELOPMENT OF TECHNICAL EXPERTISE

DATA BASE ANALYSIS

- INTER-INSTITUTIONAL ANALYSIS

ATTACHMENT A PAGE 1

DISADVANTAGES OF COOPERATION

QUESTION OF PRIORITIES

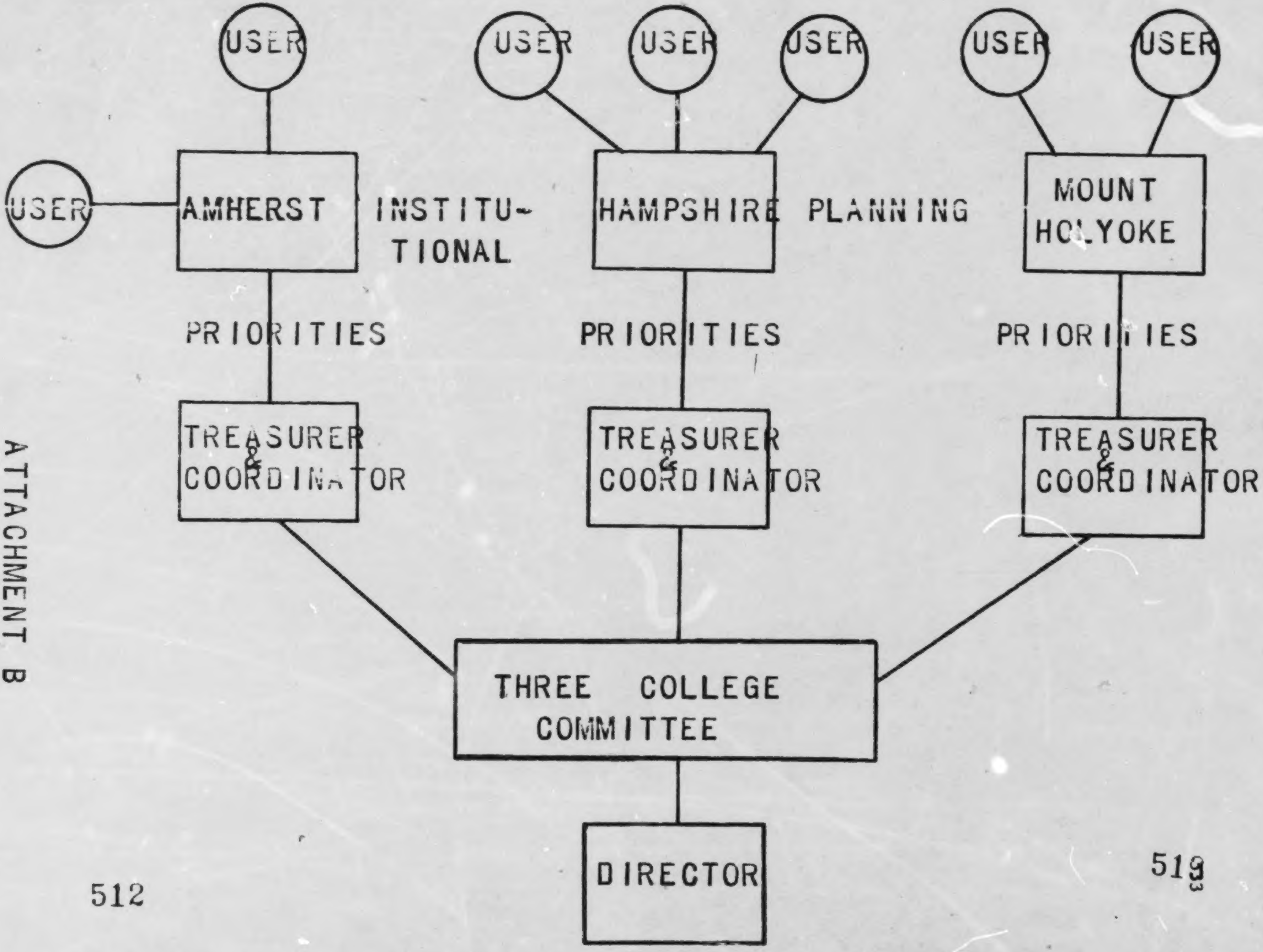
CENTRALIZATION IMPLIES INACCESSABILITY

LOCATION OF COMPUTER CENTER

SHARE USE OF A CENTRAL FACILITY

ATTACHMENT A PAGE 2

ATTACHMENT B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- user requests
- data base utility systems and interfaces
- accounts receivable/student loan accounting
- debenture billing
- student/faculty/facilities scheduling
- physical space inventory
- class scheduling
- on-line registration
- capital asset accounting
- payroll/personnel
- accounts payable
- general ledger

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SYNOPSIS: The Establishment of the University of Alaska Computer Network

AUTHOR: William M. Searcy

This presentation highlights the major challenges and accomplishments which were associated with the establishment of the University of Alaska Computer Network (UACN). The network was recently described by the Commissioner of Administration for the State of Alaska as a leader in research, statistical and modeling usages of the computer.

The five major topic areas discussed in this presentation are as follows:

- The Task - What Was Inherited

  Outlines problems associated with the demography, geography, state economics, transportation and communications in Alaska with particular emphasis as to their impact on operating a consolidated computer center in a multi-campus environment.

- The Question - Why Select Facilities Management

  Covers the facilities management question and gives a benefits analysis. Specific background on the University of Alaska decision and the rational used in selecting Systems & Computer Technology Corporation is outlined.

- The Answer - Systems & Computer Technology (SCT)

  Describes this major supplier of software and computer center facilities management. Historical data and information on the major services and benefits derived from the facilities management contractual arrangements at the University of Alaska are presented.

- What Has Been Accomplished

  Details major accomplishments in the area of networking, systems, operations, and instructional and research software. Graphical data indicative of the center's growth and acceptance are examined.

- What Remains To Be Done

  Describes some of the more significant challenges and opportunities which remain for the University of Alaska Computer Network.

"The establishment of the UACN", concludes with the author's analysis as to the future of networking and the expanded use of microwave and satellite communications to service remote Alaska.

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CONSIDERING DATA BASE AS A MANAGEMENT STRATEGY

by: Dave Clements

I. INTRODUCTION

- To CINCOM Systems
- To presentation topic

II. PRESENTATION STATEMENT: DATA BASE IS A MANAGEMENT STRATEGY

- Realizing the value of computer-stored information as an institutional resource/asset
- Understanding the rising cost of information delivery
- Accepting the notion that the institutional information resource may now be inadequately managed

III. STRATEGY: GOAL AND OBJECTIVES

MAJOR GOAL: Achieve better management utilization of the computerized information base without increasing costs. Ideally, the current rising costs of information delivery should, at a minimum, be stabilized, if not reduced.

SUPPORTIVE OBJECTIVES:

1. Secure the stored data resource by providing the utmost in data integrity, security, reliability and timely access.
2. Provide cost effective methods which will permit the data processing function to be more readily responsive to new information needs caused by changes, either in the institution's system of management of unforseen business requirements.
3. Reduce the costs associated with conversions necessary to keep up with the evolution of computing technologies.
4. Provide a fundamental position whereby the management information system may closely mirror the institution's system of management.

IV. STRATEGY IMPLEMENTATION

- Adoption of the Data Base approach
- Distinguishing natural institutional information centers
- Determining information center correlations
- Data Base schematic

V. SUMMARY

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Registration
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General Ledger
General Journal
Accounts Payable
Alumni
Development

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Don E. Gardner
Coordinator, Information Systems
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The proponents of management information systems (MIS) have held that educational administrators are in need of better management information with which to make more informed planning and policy decisions. However, while efforts to develop MIS for university administrators continue to consume valuable resources at many institutions, few (if any) successful implementations have been reported. In fact, there has emerged a body of literature suggesting that MIS projects are failing and should be abandoned, thereby freeing resources that could be used more productively to satisfy other needs.

Articles discussing the lack of success of MIS in higher education point to such factors as lack of commitment by management, lack of appreciation for the value of management information, insufficient resources, and lack of appreciation of human/political problems as reasons for failure. The following alternative explanation is proposed: MIS efforts in higher education will continue to experience frustration because success in conventional terms requires the existence of a viable management. However, most institutions of higher education are not managed; but rather administered. This important distinction, largely ignored by the proponents of MIS, is responsible for many of the perceived MIS failures. In the paper, two case studies taken from higher education are provided to illustrate some of the basic differences between administered and managed institutions. Based on the research findings of Weathersby and others, decisions in administered institutions are described as predominately political, as opposed to managerial.

The conclusion is offered that because of the on-going need for better political decision information, higher education will be better served if resources are directed less toward the development of management information and more towards the development of information for effective political position building. False assumptions and expectations have obscured the important contributions to higher education that MIS has made, is making, and has yet to make.

REQUIREMENTS ANALYSIS
IN
MANAGEMENT INFORMATION SYSTEM DESIGN

A Paper By

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Presented in Conjunction With

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General

This presentation covers some aspects of analyzing the requirements of Information Systems users with particular emphasis on developing a more structured approach to such analysis activities in a university setting. An experimental implementation of the structure, described in the paper, at Iowa State University will be discussed.

Introduction to Paper

This paper develops a decision oriented requirements analysis methodology for determining the information needs of management positions. The methodology is directed toward middle management but may be effective at all management levels. Three identifying attributes of the methodology are; orientation around decision-making, identification of long and short term user requirements, and the use of an iterative interview technique.

PLANNING FOR INFORMATION SYSTEMS DEVELOPMENT:

A LIVING CREATURE

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Like many colleges and universities, Boston University found itself well into the 1970's with computer based information systems which could not respond to the management information needs dictated by a changing student market, economic pressures and increased governmental reporting requirements. In 1973, Boston University undertook a major information systems planning study which resulted in a plan which has served as the focal point for a development effort underway for the last three years.

This paper presents a summary of the objectives, methodology and recommendations of the planning study. The process of adopting the plan by the University community is described as is the progress which has been made in the implementation of the study recommendations. The paper focuses on the importance of recognizing that a plan of such magnitude and duration will change and the need to have the plan monitored and controlled at a senior administrative level.

"SURVIVING THE CONSOLIDATION CRUNCH THROUGH THE USE OF A MINI COMPUTER"

By Donald W. Clark
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In early 1974 Central Washington University found itself faced with a severely impacted computing capability and a legislative mandate requiring consolidation of computing in the State of Washington.

In view of the mandate and by virtue of its limited and exhausted computing resources Central decided to pioneer networking by off-loading its academic and administrative work from a Spectra 70/45 DOS system to one or more state service centers.

At the same time, guided by the desire for improved responsiveness in the student information system and recognizing the failure cost of a networked registration process, Central implemented an on-line student information system using a large mini. This innovative approach has proven most successful and will undoubtedly serve as a useful pilot for other institutions facing similar problems.

Central's early efforts to meet the computing needs of the institution were typical of the growing pains we all suffered in becoming automated. Beginning with an IBM 1620 in 1964, the institution struggled for 10 years to meet its computing needs with inadequate resources. Then in 1974, by mutual agreement with the newly established Washington State Data Processing Authority, Central chose to become the first state agency to divest itself of local computing equipment and off-load its data processing work to one or more state service centers.

Many problems were encountered which required the institution to explore alternatives other than the network approach. One such solution was the implementation of an on-line interactive student information system using a mini computer. This solution proved to be very successful and provided an efficient and cost effective alternative to networking. More importantly, the mini computer and the large computer network can be a perfect marriage because the mini offers an institution low-cost, responsive on-line capabilities while the network offers large computer power and considerable growth without being "locked-in."

THE MANAGEMENT/DP INTERFACE: A PROBLEM IN COMMUNICATION

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This paper is directed toward a very critical point in the university organizational structure--the interface between the administrative decisionmakers and the data processing facilities.

It will explore the environments within which the two groups function and the difficulties encountered in attempting to bridge the communication gap. The author stresses the importance of open communication as it relates to successful planning and crisis-free operation.

Although it holds no instant panacea for the problem, the paper offers several approaches that have been operationally applied within a nine university system.

SYSTEMS DEVELOPMENT: A LOGICAL APPROACH IN AN ILLOGICAL ENVIRONMENT

Dennis Berry
University of Colorado

The traditional approach to systems development involves the specification of project tasks, the assignment of resources and their related costs to those tasks, the summing of costs to produce the budget, and the linking of tasks to produce the schedule. While this seems logical from the systems group's point of view, it is unworkable for a number of reasons which are outside of the control of the systems group.

First, management determines resources based on the relative importance of the project to the rest of the institution's activities, not on what is needed to complete the specified tasks. Second, the traditional approach assumes that the beginning of one task is dependent only on the completion of the previous task, when in fact, management decisions are more often the determinants of project continuation. Third, it is assumed that the user is able to provide an accurate definition of the problem, which is not always the case. Fourth, the traditional approach does not take resistance to change or other human factors, such as employer-employee relationships or poor planning, into account.

With these problems identified, it should be possible to work around them. The systems group must first be sure that their role as a service organization is understood by management. Management must also understand that budget, schedule, and scope are interrelated, and if one is changed, the others cannot stay the same. Schedules should be modularized around management decision points to impress upon management their role in the development process. A formal problem definition phase should be part of that schedule, and once the problem is defined, a set of objectives and the project scope should be specified. Finally, enough slack should be included to allow for the three types of tasks, the "known knowns", which can be specified, the "known unknowns", which can be anticipated, and the "unknown unknowns", which are impossible to plan for.

Data Base Administration: Still Working and Now Time Controlled

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The dimension of time has been added to mapping (control/look-up) tables and with it, historical (past and future) as well as current processing is easily handled. Such tasks as purging 'dead' records from a data base while retaining the ability to translate the codes from these archived records at a future time while retaining continuity of data is also successfully addressed. Data redundancy found in uni-time-frame tables is eliminated and thus its storage space. Additionally, in hard copy form this data becomes an information/profile source for non-data processing applications, areas, and people.

The logic involved with Activation and Deactivation dates which, when combined with the identification code of a unit, becomes the control key explains how the file is accessed. The search program indicates the point in time need. If this data is lacking, the program defaults to the current computer date. The search logic always looks for a between condition: the Activation Date must always be equal to or less than the specified date and the Deactivation Date must always be equal to or greater than the specified date. A blank Deactivation Date -- meaning the entry is the last one entered into the file for the unit -- is always assumed to be equal to or greater than the specified date.

Consider the following example:

Unit #	Activation Date	Deactivation Date	Assigned Reporting #	Additional Data			
				A	B	C	D
072	0772	0674	075	XXX	YYY YYY	Z	XXXX
073	0772			XXX	Y YYY Y	Z	XXXX
075	0774			XXX	YYYYYYY	Z	XXXX

If the search called for Units active as of September 1973 (0973) Unit Numbers 072 and 073 would be hits but Unit 075 would not be included because its Activation Data is for a later period, July 1974. If the search were for August 1977, Unit Numbers 073 and 075 would be hits, but Unit 072 would not be included since its Deactivation Date is for a time period before that called for by the search program. Still using the example, there is a second way in which this data can be used. In its hard copy form an individual can use this data as a reference guide to discover what has happened, or is going to happen, to a unit. While it becomes too complex to do a machine search to discover what a Unit has done -- 072 in the example is shown to now be part of 075 but this pointer has caused a skip over unit 073: if the pointer (assigned Reporting Number) referred to 062 instead, a loop condition would quickly result -- an individual can easily utilize this data, in proper sequence, without lines and lines of code and lost time [hopefully].

The data in these files can be added as they are developed, which is especially useful for a newly created unit: the units number and description are known and needed today, for example, but the Board of Regents Codes and HEGIS Codes will not be known nor necessary for a few more months. With the structure of this file, these requirements can be easily handled.

Our Permanent Academic Unit Number mapping file, which is the second file to utilize this technique, currently contains twenty-two data elements with more to be added in the near future. The update responsibility of each data element is assigned to a specific knowledgeable user within the University. In its maintenance format this file consists of three physical 80 byte records for each 240 byte logical record because our users are most familiar and comfortable with this format. Output reports for updating purposes have been developed which narrow to the data elements presented to those for which the specific user is responsible. In this mode, the switch out of the 80 byte record mode will be much easier.

In its working mode, this file has a BDAM structure because it provides the most advantages for our environment at this time.

THE NEED FOR AN UNDERSTANDABLE COMPUTING BILL

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ABSTRACT

The purpose of this paper is to examine the issues of a need on the part of the computer user community for an understandable computing bill. The paper is presented from the point of view of the computer user and is intended to contrast the "computer performance" oriented approach to customer billing with the actual needs of the customer-user.

The paper points out that what the customer needs is a managerial solution, not a technical solution.

DATA BASE EXPECTATIONS AND HOW TO MEET THEM

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As the capabilities of data base management systems have increased, so have the possible complexity of data bases. The problem is how to keep application development, implementation and maintenance simple without restricting the ability of the system to achieve its objectives. The organization considering data base must realize that although a data base exists to aid in the production of useful output, an integrated data base cannot exist without integrated application systems and a standardized approach to applications development. Such an approach is most easily implemented by an interface to the data base that uses control files such as an active data dictionary, parameter sets, edit tables, and other readily maintained 'systems' files. This type of interface not only aids in gaining control over application development by providing documentation of the data base, but also simplifies the implementation of new application systems.

Control over De Paul's data base environment has been established through the use of a software system built upon data base control files. The key to control is the use of a system which requires standardization and produces documentation as a byproduct of its operation. The system is flexible and easily adapted to changing user requirements. Its simplicity and parameter driven characteristics have eased the programmer-analysts burden and increased productivity.

Conceptual View of Control Data Sets

1. DICT - Data Element Dictionary
2. FORM - Documents that can enter the ACS - array of elements under a common form ID. Can also be TP screen formats for input/output display.
3. VIEW - Displays of element values extracted by system.
4. USER - Users, Files, data base controls and descriptions.
5. VALU - Data values for input editing or output translation.

Application Control System

The De Paul Application Control System can be called a Data Management System, by some definitions. It is composed of:

* Generalized Maintenance System (GMS) - A single batch job stream. Exists for the updating, all maintenance, of any and all files in the data base. Transactions (documents) entered are broken down into their component data elements which are then edited, updated to the appropriate data base files, logged and reported out to users.

* Generalized Retrieval (and Reporting) System (GRS) - A single batch job stream. Can retrieve from any part of data base to satisfy report requirement.

* Generalized Teleprocessing System (GTS) - Performs abbreviated functions in GMS and GRS above - includes full capability to examine, add, change, delete from any part of data base.

The use of Control Data Sets within an Application Control System has returned control of the data processing environment to the DP manager, enabling the organization to meet increasing user expectations.

IMPROVING THE EFFECTIVENESS OF THE PRODUCTION PROCESS

Paul A. Beirne Stanford University

Stanford's Administrative Data Processing organization has directed its efforts to improve the computer production process by designing better documents and procedures and by the unique use of some powerful tools.

At Stanford after computer systems are fully tested and documented, they are placed in production. After that, all processing is the responsibility of Production Control.

Standards were developed to ensure the best use of the resources available. An independent department was established to interface between programmers and production to insure the use of the standards. In addition, transmittal documents were designed to ease the communication problems often encountered between users and data processing departments.

Most importantly, an interactive job submission technique was installed. The base of this procedure was a text editing system developed at Stanford called WYLBUR. Its PRE-PROCESSOR facility perfectly suited our needs.

Another new tool allowed multiple jobs to be grouped together in logical units and fed into HASP with communication between jobs.

A utility program was written to simplify the problems often encountered when a restart or rerun must be made in a system using generation data groups.

Automated control features were developed which allowed systems to balance themselves while processing. This technique uses a utility program with parameter changes for individual formula calculations.

The results in quantitative terms are reduced costs both in programming and Production Control, a better than 97 percent on-schedule delivery record, and reruns of less than six percent.

Traditionally, data processing organizations devote their best talents and major portions of their efforts to develop computer systems. Even when an organization decides to use automation for itself, one of the areas which seems to remain almost ignored is the Production Control section. Unfortunately, this group is often burdened with cumbersome processing procedures.

At Stanford, this is no longer the case. The tools and procedures developed work for us; today we understand the production environment better and we've improved it in the process of understanding it.

HUMAN FACTORS
IN
MAJOR CONVERSIONS OF DATA SYSTEMS

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This paper discusses an approach to making a significant transition from a system using separate, non-integrated, data files which are accessible only through applications oriented programs to a system using the data base mode of file construction and data access. Undertaking such a task is frightening to some, resisted by others, often misunderstood and sometimes disappointing in results. Anticipation of potential hazards and designing a plan to avoid them or reduce their impacts is presented. This paper also deals with strategies such as phasing of activities, briefings and advanced preparation of key persons and some general "do's and dont's."

Managers who want to consider the management problems associated with major changes in systems will find this paper of interest. It has minimum references to the technical aspects of developing data bases.

QUALITY ASSURANCE SYSTEM REVIEWS

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Summary

In 1974 Indiana University published a blueprint for a long-range information system. By mid-1976 several segments of this information system had been implemented. Along with successes also appeared several critical problems:

1. Overloaded hardware
2. Computer down-time
3. Delays in producing output
4. Inconsistent design philosophies
5. Costliness of redesign
6. User and management dissatisfaction

By mid-1977 the quality assurance function was established at Indiana University.

The system review process is a major component of this function. The primary objective of systems reviews is to assure the quality of the product before it is built. This objective is accomplished by designating quality assurance teams made up of key personnel from each of the major areas within the department. Each major system under development is reviewed either formally or informally upon completion of each of the six phases of the development cycle. All decisions are documented and disseminated to departmental managers. Approval of each development phase must be obtained before commencing the next phase.

After conducting reviews over the past three months, the following observations can be made:

1. Products being developed are more thoroughly defined and documented.
2. Better communication and understanding of systems under development is relayed throughout the department.
3. Missing or obsolete standards are recognized and are replaced in the departmental standards Manual.
4. Checklists required for system review meetings require enhancements.
5. One additional quality assurance resource person is required to enable all reviews to be conducted and to assure that all decisions made are carried out.

Using Institutional Data to Analyze Certain Aspects of Quality in Educational Programs

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In recent years many colleges and universities have become aware of falling admissions test scores, grade inflation, and declining literacy of their graduates. These findings have prompted some institutions to develop new, more stringent standards for admission, grading, and graduation. These efforts are, for the most part, commendable; however, they fail to address another far less publicized problem relating to the quality of academic programs themselves. In fact, we know so little about the area of academic program evaluation that those of us who are interested can only suspect that a problem exists. This paper suggests some ways in which institutional data such as grade and course records, student profiles, etc., can be used to begin an analysis of academic program quality.

VIRGINIA TECH'S CIRCULATION AND FINDING SYSTEM AS A DESIGN AND IMPLEMENTATION MODEL FOR LIBRARY AUTOMATION

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If elephants were designed by committee, outward appearances indicate that computer based library systems have frequently been designed by committees of elephants. But a bizarre outward appearance may indicate an inner need that must be met if the creature is to survive. Libraries operate under far more complex rules than commonly perceived and the analyst's desire to not build griffins has left a legacy of dinosaurs.

The key administrative ingredient of Virginia Tech's Circulation and Finding System is the enforcement of hand-offs of authority and responsibility. Details of this design and implementation technique are given and the approach is expanded to include efficient software sharing between dissimilar libraries.

USABLE INFORMATION

A Pragmatic Approach to Building a Faculty Personnel Information System

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Personnel information systems are less useful than they should be. There are a number of reasons for this, most of them stemming from the relative youth of the computer revolution.

Administrators tend to be unknowledgeable about the technical implications of machine data processing. Data processing staff, for their part, are generally unaware of the ambiguities of the decision-making environment in which their reports will be used.

As a result, large amounts of data are routinely produced but only occasionally are really useful to administrators as they deal with day-to-day problem situations. The considerable adaptive potential of the computer is largely unrecognized and untapped.

Berkeley's new academic personnel information system (APIS) has focused on providing usable information quickly and accurately to the various units of the chancellor's office. APIS is mounted on an interactive, time-sharing PDP-11/70 minicomputer, and run in-house. The operating system is UNIX, to which APIS has added, with the help of the graduate division, data entry and retrieval software of its own. APIS has no operational responsibilities for either the faculty personnel or payroll systems.

Care has been taken to include only those items in the database that can be systematically entered, corrected and updated within the resources of the APIS staff. The working assumption has been that speed and accuracy over a carefully delimited set of essential data elements are more valuable to the users by an order of magnitude than the existence of large amounts of miscellaneous and seldom used data. Because of APIS' close physical and operating relationship with the academic personnel office, the database can be corrected and updated with a minimum of delay. Most requests for information can be filled within twenty-four hours, a time frame that normally allows for several valuable occasions of interaction with the person or office making a request.

APIS makes as few prejudgments as possible about the details of the reports it is asked to produce. This approach flies somewhat in the face of the conventional wisdom that an information system should be built around previously known user needs. The needs are known generically and the interactive computer environment permits both preliminary exploration of the database and rapid modification of reporting formats. Both of these capabilities have proven valuable in producing information that is precisely responsive to requests.

These and other related ideas have been incorporated into the faculty information system. None of them are new, but collectively they seem in practice to have considerable power to produce an effective faculty personnel information system.

STUDENT RECORDS WITHOUT COMPUTERS: A Small College System

by Jack C. Dahl

While most institutions of higher education are developing more complex and sophisticated computer-based systems for maintaining student records, many small colleges have chosen to stay with manual records systems. This decision most often reflects a desire to avoid the costs and the depersonalization inherent in computerized student records systems. However, many of these manual systems are inefficient, relatively inaccurate, and may even be detrimental to the public image of the institution.

A model student records system has been developed for what is called Small College. The system has been designed to eliminate the collection of unnecessary and redundant data wherever possible, to facilitate maintenance of adequate student records, and to provide accurate and timely information to faculty and administrators. The system has also been designed to improve financial control of student charges and to minimize the involvement of faculty members in clerical record-keeping activities.

The first module in the Small College system includes recruiting and admissions. The model recruiting records procedure includes a three-step process for initial contact and subsequent follow-up with prospective students, culminating with submission of an admission application or purging from the file. The checksheet used to manage this procedure is also designed to enhance the ability of the institution to analyze the effectiveness of its recruiting effort. The admission procedure begins with receipt of the application, includes notification of admission to the student and follow-up of non-matriculating students, and concludes with creation of an academic record for matriculants.

The second module of the system includes the semester cycle of activities. This cycle begins with the five steps in the registration system. Registration Clearance begins the process by checking the eligibility of each student to register and by issuing a registration card to each student who has no outstanding financial or academic obligations. Program Advising includes approval of each student's intended program by his advisor. Fee Assessment and Collection includes making payment or arrangements for all financial obligations, as well as awarding of all financial aid. Class Schedule Confirmation includes processing registration forms, pulling class cards, and confirming the student's registration. Information Distribution and Reporting provides information to both faculty and administrators. The same general procedure is used for drop-add and other such changes made later in the semester.

The second module of the system also includes processing of midterm and final grades. Midterm grade rosters are prepared from the updated registration cards and midterm grade forms are prepared at the same time. Final grade processing uses the same grade rosters and only requires preparation of a new set of grade forms. This module of the system is completed when the final grades have been processed and the permanent records are ready for posting.

The final module of the system includes permanent record processing. The permanent record is started for each student when he matriculates, and it is updated by posting courses and grades each semester. Degrees are awarded and placed on the permanent record when the degree application forms are approved. After the degree has been posted to the student's permanent record, the student's file can be purged of extraneous materials and moved to an inactive records file. This module also includes transcript preparation and transmittal, and the transmittal record is maintained on the back of the permanent record. Alumni office notification of new graduates may also come at this time.

In addition to these basic modules, the system includes some optional procedures. Attendance in class can be monitored and absences classified as excused or unexcused. Exit interviews can be conducted and used for both financial account clearance and analysis of the student's reason for termination. Additional optional procedures can be added without affecting processing activities carried out by the basic system modules.

Even in a relatively simple manual student records system, there are numerous tasks that must be accomplished on a regular schedule. A functional calendar of student records activities has been developed as a quick reference and planning guide. With these basic system modules, operating within this general calendar, the system has been designed for operation by one coordinator of student records. The only supplemental personnel needed for operation of the system for up to 500 students is during periods of registration processing.

INTEGRATED ON-LINE COURSE DATA BASE

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In the Spring of 1976, State University of New York College at Buffalo determined that one of the primary objectives of the campus was the improvement of the student record and registration system. This decision was based on a number of contributing factors. The College was receiving more requests for detailed statistical information from both on-campus and off-campus sources. More accurate data was necessary to aid in better decision making. The College had outgrown the present record system as a result of College policy and curricula changes. For example, the College had undergone a major academic reorganization condensing 42 academic departments into 26.

After extensive research and study of current and future campus needs, we decided to create an on-line data base for easier file handling and elimination of data redundancies - STARS, Student Transcript, Admissions and Records System.

We had available to us a Burroughs 4700 with 200K memory, two 9-track 800 bpi tape drives, one 800 line-per-minute printer and one million bytes per track disk storage. We also determined that we would need visual display terminals and software to handle data base techniques and a terminal handler. As a result of time and staff constraints, we chose to use Burroughs FORTE2 (File Organization Techniques) and NDL (Network Definition Language).

STARS consists of five segments: financial aids - which consists of loan, grant and scholarship data for students, admissions for both graduate and undergraduate students, course offerings as listed in the catalog and master schedule, transcript - a student's complete academic record and registration including advance, manual and drop/add data.

This presentation will focus on the course segment of the STARS data base. The course segment was designed to achieve two goals: 1) maintain the College catalog course offerings and 2) maintain semester course offerings. In order to accomplish the first goal, a catalog file was developed. To accomplish the second goal, four files were developed: section, time, room and building.

The course segment was designed as an on-line system for three reasons: 1) To provide departments with immediate representation of data; 2) To decrease the volume of paper and time needed to produce this paper; and 3) To place in the departments the responsibility of the data they were generating. All files in the course segment are updatable thru visual display terminals.

The course data base exists currently with the catalog file as the main controlling feature of the system. Section, time, room and building files maintain the scheduling portion of the system.

The catalog file contains one record for each section of a course. The time file interrelates with the section file and contains one record for each meeting time of a section. The building and room files interrelate with the time file and provides for one record for each individual time record.

In the future, the course data base will interface with the student segment of STARS thus producing a fully integrated data base.

FEDERAL LEGISLATION AND ITS EFFECT UPON UNIVERSITY INFORMATION SYSTEM RESOURCES

by

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This paper presents brief summaries of federal legislation which pertain to higher education in the 1970's and presents some of the demands of this legislation on the information system resources of institutions.

DOES THE PAYER OF THE PIPER CALL THE TUNE?

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Recent revelations about managed news, "cover-ups," false advertising, and less than full disclosure or inadequate research and investigation in government and industry, have caused skeptics to question the credibility of reporting, advertising, and research at colleges and universities, with the underlying contention that the decisions being made in Higher Education are based on less than complete and objective data. In the middle of the "who and what to believe" controversy are the researchers, analysts, and data managers responsible for the reporting and control of the data.

At issue in this paper is whether researchers and analysts, who are typically responsible to the administration and who are generally considered administrators themselves, can in fact be "objective" and "independent" in evaluative and analytical research about the institution, its programs, and its policies. Discussion of the objectivity and independence of institutional researchers centers on answers to the interrelated questions of "for whom do the researchers work?" And "what research do they do?" The opinions expressed in the paper have a factual basis at least to the extent that attitudes and opinions of institutional researchers, and others responsible for institutional data services, represent an accurate assessment of reality.

While most offices of institutional research are directly responsible to some higher administrative authority, the prevailing attitude is that administrative control is not in itself a conclusive argument that researchers and data analysts are less than scholarly in their work or unduly influenced in their findings or conclusions in the superior-subordinate relationship. An overriding concern, however, is not with intervention or manipulation of research, findings, or conclusions by administrators, but rather with the more subtle control which can be exercised by questions the administration asks and work it requests. There is some evidence that the administrator can exert control over the research through administrative action and decision. That control, in the minds of some faculty and researchers, is sufficient reason to invalidate the work of the institutional researchers. Facts and reason, however, suggest that it is the administrator who should be asking questions and seeking "objective" research for management and decision making.

The general consensus, among researchers at least, is that while their efforts may be directed by the administration, it is not an infringement on their objectivity: in fact, most researchers believe they would lose their jobs if they were not objective in their efforts. Nor is it necessarily an infringement on research "independence" to seek answers to the questions and issues raised by administrators, faculty, or students who need the services of the institutional research office in facing institutional problems: in fact, most researchers believe that the purpose of an institutional research office is to serve those needs.

The greatest threat to the objectivity and independence of institutional research appears to be the growing necessity to provide external users with institutional data. Federal and state forms come complete with definitions and response forms, which may or may not conform to the institution's use of the data, but which nonetheless must become the standard for data collection and maintenance. Data requests from state coordinating agencies or controlling boards are also taking up an increasing amount of the researcher's time and with the same general outcome: little or no institutional pay-back or utility from the work. The verdict is still out on whether the push for centralized data systems at the state and federal level is for efficiency or motivated by mistrust.

At this point in time, however, the general consensus is that faculty, students, administrators, and regents are willing to accept the data and the reports of the institutional researcher as an impartial representation of fact.

STATEWIDE DATA COLLECTION: STRENGTHS, WEAKNESSES AND POSSIBILITIES PERCEIVED BY INSTITUTIONAL RESEARCHERS

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The Georgia higher education system undertook the development of a comprehensive management reporting system. Whereas each of thirty-three separate institutions, ranging from small junior colleges to large comprehensive universities, previously reported autonomously, this management information system imposed structure and consistency.

This paper describes the statewide data collection system comprised of an interdependent set of five sub-systems to present a dynamic view of activities and resources. Strengths and weaknesses of this management information system and its impact upon the internal operation of one university are presented as experienced by an institutional research staff.

IMPACT OF COLLECTIVE BARGAINING ON COLLEGE AND UNIVERSITY MANAGEMENT INFORMATION SYSTEMS

by

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The objective of this small scale research and development activity is to examine the nature and functioning of our contemporary management information systems (MIS) under the present context of one aspect of university governance - collective bargaining. It should be emphasized at the outset that the investigator is not going to analyze the technical aspects of university MIS. Because new kinds of relationships within an institution (or between an institution and the external world) have taken place, it is imperative to predict their impact upon the development and the use of an information system.

Consider, then, the increasing role of collective bargaining, especially academic collective bargaining, on the campus. The "collegial" style of governance now co-exists in uneasy juxtaposition with the "adversarial" mode formally inherent in the structure of collective bargaining. In this new context, information systems are bound to become objects first of study and then of dispute.(1) Access to information is demanded: is not information power? Getting "an agreed statement of facts," however, in an adversarial situation is frequently as difficult as settling the dispute itself. Not only the use but the very foundations of our information systems will then come under scrutiny and attack.

The essence of the matter is as follows: rather carelessly, we have become used to thinking of "information" as just neutral "input" into a decision-making process. But "information" is itself "output". Now, questions are pushed and arguments ensue over such issues as: just what was the input into your information system? What values, whose values, and whose "judgment calls" does it presuppose?(1)

The approach in this study will be based on the examination of two recent documents - the Collective Agreement Between Carleton University and the Carleton University Academic Staff Association, (December 11, 1975), and the Memorandum of Agreement Between the Governing Council of the University of Toronto and the University of Toronto Faculty Association (to be ratified

Spring 1977). The investigator will interpret these documents - clause by clause - and attempt to determine the data requirements and informational consequences.

Therefore, this small scale research and development activity will address itself to some combination, or all, of the following questions:

-what kinds of data needs are being generated during the process of collective bargaining?

-which data items are presently easily accessible and available?

-which items are internal to the institution in question?

-which items are external to the institution in question?

-will it be necessary to establish a small secretariat in order to provide the single base of valid facts, hence increasing administrative costs?

-who will settle questions of definitions and interpretation of data items provided in the collective bargaining process?

-to what administrative category will the costs of maintaining, validating, and updating data needs for collective bargaining be attributed?

-will external parties, for example, another university or an agency of the government, have access to this information? If not, why not? (Ontario universities, being public-funded institutions, should provide access to information).

-will a collective agreement require the generation of professors' dossiers that will contain pertinent material such as curriculum vitae, diplomas, evaluation on teaching and research, workload, and other items?

-will collective bargaining lead to the development of comprehensive computer models devoted to projecting institutional and non-institutional costs?

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1). Sibley, W.M. "The Transactional Frame of Information." An address delivered at the Fifteenth Annual Forum of the Association for Institutional Research, St. Louis, Missouri, April 28, 1975.

NETWORK INTERACTIONS: INTERNAL AND EXTERNAL VIEWS

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These papers discuss different perspectives regarding the development of common programs and network capabilities. For the past several years the authors have represented different sides of the question of using a major university facility to host a statewide network of state colleges and community colleges. In back-to-back presentation, they will share their experiences. One author is also responsible for management information for a statewide board and the other author was formerly the dean of students at the University and before that, registrar at MIT. They will discuss both management expectations and data processing realities of sharing hardware and systems developments.

Is There A Due Process In Planning MIS and Models?

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The basic purpose of this paper is to show a direct relationship between governance-decision making-management-planning, MIS and models. That relationship shows that planning, MIS and models reflect the varied states of the art of governance, decision making, and management in higher education. Planning, MIS and models are generally stated as planning in this paper, yet the reader should be aware of the significant differences between the three terms.

For the purpose of this paper there are five basic tenets which will be helpful to the reader and more fully illustrate the concept given in the paragraph above:

1. Governance involves the comprehensive total of those involved in the decisions about essential issues of purpose, program, and resources. Yet it should be also recognized that the governance function and group are not equal in power or that which they govern.
2. Decision making by the governance group should usually be based upon broad principles of policy and clearly stated objectives (something that seldom happens in higher education).
3. After the governance group makes the decisions, the management is to act upon those decisions of those governing by using Planning, MIS and models among other tools. Management does the planning and may help set the goals of planning or structuring the situation so as to imply goals.
4. Leadership in all phases of governance, decision making, management and planning is vital to organizational behavior and success.
5. While theoretically one may expect a continuous line of

descending authority from governance, decision-making, management, planning the continuity is fractured and is not hierarchical in practice.

The diversity present in higher education then dictates a variety of due processes as they now truly exist. The ideal situation would be that each institution would create a more continuous line of proper procedures beginning with representative governance, a moderately democratic decision-making process and a responsible management to carry out the decisions in the best interest of those governing.

Evidence of recent surveys shows that governance is actually more the product of administration acting as management but with little input from faculty, students, or trustees. The potential development of a strong autocratic president acting within shared authority and encouraging input from the governance structure may be the better model for planning with the most ideal use of MIS and models. Where governance is shared, input is respected and where budget as funding is tied to clearly defined objectives, commonly agreed, then planning will be successful.

Decentralization Of Data Processing Professionals - Its Impact On The Personnel Office of Virginia Polytechnic Institute and State University

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The decision to decentralize data processing professionals has the potential of producing a significant impact on an organization. Whether this impact will be positive or negative will depend on the thorough review of all advantages and disadvantages before implementation. If done properly, decentralization can be the means to achieve more efficient and effective use of management information systems.

According to the classical theory of organization, decentralization is a process whereby a higher central source of responsibility and authority transfers certain functions to subordinate individuals and groups. The recipients of the transfered functions may be managerial or operative, line or staff. It should be pointed out that in conjunction with the delegation of duties there must also be the appropriate level of responsibility and authority assigned. How else can the individuals and groups be held accountable for the results of the decentralization? At the same time, the higher central source cannot divorce themselves from the situation. Ultimately, they are responsible for the actions taken by their subordinates.

Introduction of a computerized data management system and its associated personnel can have an impact on an organization. The dysfunctional side effects stemming from behavioral problems generated by this revamping of an organization must be minimized. It should be noted that this will occur throughout all levels of the hierarchy. Some individuals will not understand the new technology while others will not believe it to be wise to use a system that has not been proven to operate properly. The long range effect of committing to a management system will also be questioned.

The function of a decentralized data processing professional is a multi-faceted one. To be technically proficient is not enough. As has been stated in recent issues of ComputerWorld, it is more important to be able to communicate. If the user office cannot comprehend, technical expertise is lost. Therefore, an "internal translator" should be in the makeup of this individual. That is, they should possess the skills to relate to the user office in a manner they can appreciate. It will still be apparent that the individual is technically competent. Lack of communication can do more to impede a project than lack of technical background.

The purpose of this paper is to explore this concept and attempt to relate to others how this type of commitment might enable their office to better serve itself as well as the college/university environment. The decentralization of the professional staff into the larger offices at VPI&SU has provided for more efficient and effective use of the computing faculty and data base management system.

A COMPUTER ASSISTED JOB SCHEDULING, JCL GENERATION, FILE LIBRARY MAINTENANCE, PROCEDURE TESTING AND DOCUMENTATION SYSTEM

ISU JOB PROCEDURE LANGUAGE SYSTEM (ISU-JPL SYSTEM)

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Computer Based Information Systems Analysts, Programmers and Managers invariably discuss the complexities and difficulties of developing and maintaining data processing procedures. Generally this is due to the complex nature of computer job interactions, job control languages, file interaction, library maintenance controls and continual change in data processing environments. While the computer has directly been used extensively for on-going applications work, in many cases it has not been used to an appreciable extent as an aid for computer personnel in developing systems for their users and for managing the Data Processing environment.

The ISU-JPL System had its beginning in 1970. Our original goal was to maintain identical job procedures for the control section and the analyst/programmer sections. Prior to this time if one section would become aware of an update or correction, it was difficult to depend on this information being communicated to the other section with the same results. A second major goal was to support the documentation of the large number of job procedures that were requiring a large amount of technical and secretarial help for maintaining semi-accurate and legible documents.

As the job procedure system progressed, these two goals were accomplished and the file became very useful in searching out conditions that required updating to meet the demands of computer system changes. Because of the standards and strict adherence to them, we became aware of a multitude of additional features available to us. A main advantage now is the generation of OS/VS1 JCL, as this relieves the staff of the tedious task of creating JCL. This also assures the standardization of JCL. The improved quality of our documentation is also realized as an asset by our staff.

An example of how the ISU-JPL System was a great asset to our Center was during the conversion from DOS to OS which was done without additional demands on the staff, other than the programmer who wrote the computer program to generate the new OS/JCL.

As we look into the future, the ISU-JPL System is expected to be very instrumental in conversions that will be forthcoming. For example, new software might decrease the sort work areas needed by 30%. To make this change a computer program could recalculate the number of tracks for the sort work areas for all procedures and generate a new procedure file with the updated source statements reflecting the changed sort work area. The updated procedure file would then be processed by the JCL generator to update the PROC.LIB. for all jobs using sorts. This would automatically make all PROC.LIB. procedures current. Other examples might be to automatically change procedures and JCL for magnetic disk and tape configuration changes, printer changes, analyzing the possible effects of changes in compilers (such as a change in support level), hardware, etc.

We feel that the major measurement of success of the ISU-JPL System is that it greatly enhances the analyst/programmer production capability and our staff has become very appreciative of such advantages. The coding is analogous to programming; therefore, it is natural to use and is used without hesitation. These successes are very important at a time when labor costs are becoming more prominent than hardware costs in Data Processing Centers.